INTERNATIONAL HELLENIC UNIVERSITY

The impact of Artificial Intelligence in Tourism Industry: A Systematic Literature review

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SCHOOL OF SCIENCE & TECHNOLOGY

A thesis submitted for the degree of

Master of Science (MSc) in E-Business and digital marketing

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THESSALONIKI – GREECE

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Abstract

This dissertation was written as part of the MSc in E-business and Digital Marketing at the International Hellenic University.

This study aims to research, identify and discuss the impact of Artificial Intelligence (AI) on the current state of tourism sector. Our motivation, initiated from the tourism's paradigm shift into a data driven industry and the observed need for innovation and differentiation among its players. Tourism and Information and Communication Technologies (ICT) are long interconnected, thus AI for the majority of the market remains undiscovered. Our approach, attempts to bridge the sector's strategies with AI implementations, underlying benefits and challenges throughout the connection. The methodology is a systematic literature review, based on scientific publications that demonstrate the topic from both, business and technological perspective. Our findings, identify the AI value creation and challenges that arise in supporting tourism and can be summarized in the increased efficiency, productivity and profitability that AI can create to tourism suppliers combined with an extremely rich and personalized experience that can offer to travelers. We conclude, that the acknowledged challenges can be bypassed with a tactical and strategic AI adoption. Such an adoption will stand critical for the competitiveness and resilience of the sector. Based on the results, we intend to draft and publish a paper hoping to inspire future researchers and raise the dialog for the future of tourism.

Acknowledgments

Contents

1 Introduction

Our introduction includes a historic review of "Information and Communication Technologies" (ICT) impact in tourism and the opportunities that appear in the current era for tourism industry, through data and technologic infrastructure. Then, in our second chapter, we introduce the state-of-the-art in tourism, by introducing the major players and we describe the paradigm shift of the industry through the main disruptive factors and challenges that affect it. Our third chapter, is dedicated to the methodology we followed for our review, regarding the research area and criteria of selection and it also makes an introduction into the "Artificial Intelligence" (AI) topic. The fourth chapter presents the results of the systematic literature review while our fifth and sixth chapter discusses the findings and summarizes the main conclusions of the paper along with our future work.

1.1 Historic review of the affect

As ICT are embedded in our daily lives, work and entertainment, they are also a fundamental part of the way we travel. Using ICT in tourism industry has a long history, starting from the 1970's when the "Computer Reservation Systems" (CRSs) where established, followed by the "Global Distribution Systems" (GDSs) in the late 1980's and bloomed with the development of the Internet in the late 1990's. Since the year 2000, we notice the transformative effect, into core operations of the industry, through the automation of many tasks (e.g. e-tickets, on-line hotel booking). The term e-tourism was introduced (Law, Buhalis, & Cobanoglu, 2014) as "the digitization of procedures in the tourism sector, including both the tactical and strategic adoption of ICT applications that facilitate organizations to maximize their efficiency and effectiveness". E-tourism empowered the distribution and marketing of the touristic products and along with the technological revolution experienced through the development of the Internet and the social media, (Chuang et al., 2017) it has disrupted the market conditions for tourism organizations (Ashari, Heidari, & Parvaresh, 2014).

1.1.1 The Data Age

In the post 2009 literature, analysts define our era, as the "Data Age" seeking interest around the following four data characteristics: volume, velocity, variety and veracity. The "Data Age" is defined as "the age, in which every thing or object that is surrunding us is instantly linked (Alfaro Navarro, López Ruiz, & Nevado Peña, 2017) to a data source and our every move is captured digitally" (Low, Cheng, Wong, & Motwani, 1996). Particularly in the tourism industry, on-line car reservations, hotel bookings, rooms' or taxi drivers' reviews, social media pages, enterprise data bases, in-room sensors or wearable sensors like, "Disney's magic bracelet" (Disney, 2016) are examples of these data sources. The increased contribution of information using digital media from end-users, also known as content creation, has added on the staggering amounts of accessible information, from "big data" to public sources of "open data". New terms as the "Global Data-sphere", defined as "the annual sum of all data created, captured, and replicated on our planet" - referred also as digital existence - are introduced, underlying the eminence of data (Reinsel, Gantz, & Rydning, 2017). Our "digital existence" is growing and reveals unique user experiences and an new era of business opportunities (Reinsel et al., 2017).

1.1.2 Technologic Infrastructure

In addition, computing power becomes increasingly distributed among smaller businesses and cloud infrastructures are commonly used, democratizing the use of data. Smaller family hotels, for example, can store its clientele in the "cloud", making use of a storage infrastructure which cost; was otherwise addressed only to big hotel chains. Sophisticated algorithms, expand the analytical and processing capabilities of digital networks that are often placed in the cloud as well. Smart devices (mobiles, tablets and wearables) provide accessible information and computing power to users and travelers around the world. As a result, the technological reach is distributed independent of time and location. This more balanced "distribution of infrastructure, the blend of mobile devices and affordable wearables, big data and AI is set to reengineer the sector" (Floater & Mackie, 2016). Tourism industry and the way it operates, standard daily and legal procedures, create enormous numbers of data, considering only, the data need for a flight booking for example (Guan & Du, 2016).

1.2 Insight Opportunity

Analyzing the stored data can transform "orphan" data into information and those, in business insight. That is why, tourist businesses globally are focusing on setting the basis of the upfront technology for capturing this opportunity. The current aim for many businesses in the tourism sector independent of their size and power, as Expedia's CEO introduced in the book "Hotel Pricing in a Social World: Driving Value in the Digital Economy" (Schuckert, Liu, & Law, 2015) is to "stay relevant and competitive". Driving value out of data can be one option towards this direction, at a point when ICT dynamics resulting in an increased rivalry among industry's players, whose bargaining power and their ability to communicate directly, jeopardize the role of intermediaries (Ashari et al., 2014)

2   Tourism and the current state of affairs

Following the basic introduction our second chapter, presents the current state of tourism sector growth in detail, and the identification of the key players. This chapter closes, with the identification of the disruptive factors that transform tourism into a "data driven" industry.

2.1 Tourism in numbers

Despite the boom of terrorist attacks, the political crisis and global economic uncertainty, the results of 2016 as noted by "World Tourism Organization" stated that "worldwide outbound travel remains on the growth path": the number of worldwide outbound trips grew by 3.9%, driven by Asia with an increased rate of 11%, including 18% growth in the rapidly developing Chinese market, and the USA in a 7% increase accordingly. More specifically terrorism, as an unpredicted factor proved "beneficial" for European destinations, who were recognized as – rather - safe, while international travelers turned away from impacted countries with a traditional touristic culture, such as Turkey. Asia and USA also generated good growth as World Tourism Organization's (UNWTO) "Tourist Barometer" reports (Eurostat, 2017): "the outlook for 2017 is also very positive, with world outbound travel predicted to grow by between 4% and 5%, driven once again by Asia and the USA, with stronger growth out of Europe". Tourism proved resilient to the economic crisis and provided new jobs for young people, this positive growth along with the technologic boom has created a profound opportunity for innovation.

2.2 The major players of the sector

In this part, we introduce the major stakeholders in tourism. According to the "World Trade Organization" (WTO) survey on the "Implementation of the Global Code of Ethics for Tourism" (WTO, 2017), the term "stakeholders" in tourism development includes, the following players:

a. "National governments"

b. "Local governments with specific competence in tourism matters"

c. "Tourism establishments and tourism enterprises including their associations"

d. "Institutions engaged in financing tourism projects"

e. "Tourism employees, tourism professionals and tourism consultants"

f. "Trade unions of tourism employees"

g. "Tourism education and training centers"

h. "Travelers, including business travelers, and visitors to tourism destinations, sites and attractions"

i. "Local populations and host communities at tourism destinations through their representatives"

j. "Other juridical and natural persons having stakes in tourism development including non-governmental organizations specializing in tourism and directly involved in tourism projects and the supply of tourism services"

For the purposes of our study, we focus on two out of the above-presented players: "tourism establishments and tourism enterprises" who represent the generalized term of "suppliers" and "travelers, including corporate travelers, and visitors to tourism destinations, sites and attractions" who represent the "consumers". Analyzing further these two stakeholders and building on a categorization introduced in Floater & Mackie's Report on travel distribution (2016), we discuss in more detail the suppliers and consumers.

2.2.1 The suppliers

The report of "London Scholl of Economics" (LSE): "Travel Distribution: The End of the world as we know it?" identifies on the suppliers part the below players:

a. *"Airlines",* can be identified as a major stakeholder in tourism industry. Categorized in "Full service carriers" (FSC), "Low cost carriers" (LCC), "Hybrid carriers" and "Private jet clubs"; airlines' profit margin has been growing, with a profitability that grew to 35.3 billion USD, in 2015. Innovation, integrated automations and generally, gained experience in ICT impact is noticeable, as they have witnessed numerous changes in both strategic decisions (capacity levels and airport design) and day-to-day operations like handling travelers' flows and routine procedures like check-in, in the past.

b. *"Hotels"*, categorized in independent hotels and brand chains. Global hotel industry comprises an estimated 16 million rooms and creates revenues of 550 billion US dollars. The hotel sector presents a highly fragmented and competitive nature that makes the need of differentiation and direct revenues. In addition, the expansion of sharing economy platforms, such as "Airbnb", initiate another swift in the business models of the hotel industry.

c. *"Car Rentals"*, represented by some global brands and mostly by local independents. A more general categorization of personal transportation, is including here, not only car rental, but also taxi – short term - rentals. This category, has been disrupted significantly from sharing economy platforms as also has been the hotel industry, as previously presented. To name a few of those platforms, apart from "Airbnb" there is "Uber", "Cabify" or "Haxi", together they have been very successful in attracting new content in the industry, via unused resources (e.g. rooms or cars), fragmenting the industry further.

d. "Travel Agencies", which enclose: the offline-travel agents with bricks-and-mortar businesses (traditional on-road agencies), as well as "travel management companies" (TMCs) which serve corporate travelers along with the "online travel agencies" (OTAs) and "metasearch engines". OTAs have grown incrementally and are changing the landscape of travel distribution rapidly; taking advantage of the ICT application that ensure the best customer experience and their very low operational costs and medium risks, considering that their business model is based on commission.

e. "The Gatekeepers", are companies such as "Google", "Facebook", "Microsoft", "Amazon" and "Apple", who also are found in the literature as the "tech-giants" since they have the access and the control of the data and eventually decisions and behavior of their users (whose number, respectively, is translated in millions of people). Taking full advantage of ICT, and in many cases initiate themselves new developments, those "giants", impact the majority of sectors including tourism. Particularly their business models on advertising and marketing disrupt the distribution of touristic products and travel, e.g. hotel reservations, flight booking, travel packages, car rentals etc. The rise of their power is translated as the "suggestions net", that drives and directs consumers towards particular airlines, hotels or travel agents. Apart from the recommendations and advertising abili-

ties, "Gatekeepers" access personal information that allows them to create accurate consumer's profiling. The targeting they are capable for, based on data analytics and the "reach they succeed though direct messaging" (Floater & Mackie, 2016) is at the moment, the most powerful marketing strategy for the industry. It is already stated, that their power endangers metasearch engines, and thus many "traditional" stakeholders are awaiting for regulations that could set a barrier to Gatekeepers' overexpansion.

2.2.2   The consumers

According to WTO's Annual report in 2015, tourism sector contributed 9.8 % of world GDP. Along with the positive numbers of growth described above, we conclude that consumer demand for travel is up and strong. Yet, tourism demand has an interdisciplinary nature, depending on general economic conditions, consumer confidence and disposable income among other, less robust factors, that is even harder to predict. The "Future Traveler Tribes 2030" report by "Amadeus" (Tomorrow, 2017) has already prepared businesses by presenting "The 6 future consumer's segments" that will change the current targeting strategies:

a. "Social Capital Seekers: relying and deciding upon peers power and their social media content"

b. "Cultural Purists: experimental traveler who seeks for different cultures, away from his/her daily life"

c. "Ethical Travelers: planning on ethics, e.g. environmental grounds"

d. "Simplicity Searchers: stressful free planning, mostly by package offerings"

e. "Obligation Meeters: a mix of corporate and leisure customer who is time and budget limited"

f. "Reward Hunters: interested in indulgent travel, craving something that represents an extraordinary reward or 'must have' premium experience."

The literature is supporting the above findings and according to Gretzel, Sigala, Xiang, & Koo (2015) consumers are "re-educated on the sharing economy mentality and the tech intergraded travel environment". Airbnb has changed consumers' expectations for accommodation, introducing new standards in the provided services. Consumers are looking for local experiences, inspiration, smooth booking process and respon-

sive services. Moreover, in the social path, consumers are searching for opportunities to reflect and share their experiences across their travel life-cycle; privately, with friends and family or publicly on social media. Technology, place a profusion of choice at consumers' and travelers' fingertips, for example, they can now compare, in real-time, travel packages offered among many other customized suggestions of products.

2.3   Tourism paradigm shift

The fast growing and changing sector presents "one settled factor, the one of disruption" (Buhalis & Law, 2008). The shift towards experience and away from materialization along with the highly competitive environment (Liang, Schuckert, Law, & Masiero, 2017) push the players to focus more on information and data. This focus is described as the paradigm shift of the tourism structure from a service industry into a data driven industry (Tourism Intelligence International, 2012). The swifts occur towards knowledge platforms and value networks, where mass, standardized and rigidly-packaged forms of tourism is replaced by targeted marketing, customization and unique experiences.
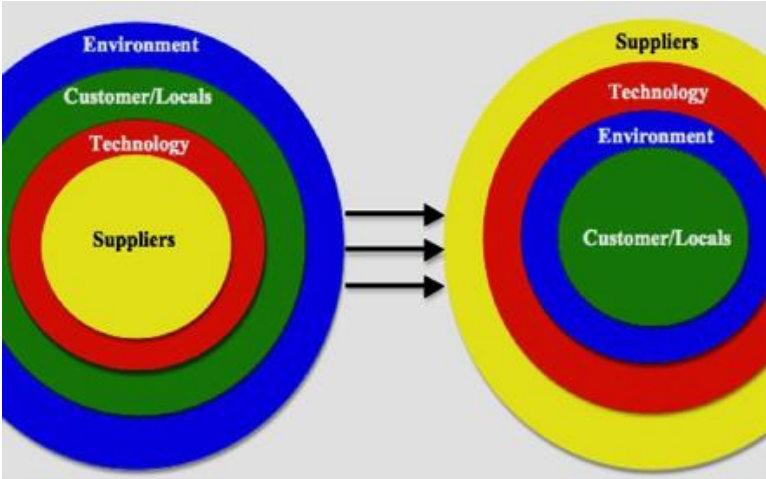

Figure 1 The Paradigm Shift in Tourism

Source: Tourism Intelligence International, 2013

The customers and their needs move to the core, (Figure 1), are Customers eventually drive the industry itself. The available web content and sector's data is now key for the industry: it becomes the link between businesses and consumers. To serve customers

the tourism industry needs to understand their needs and adjust to them, with new and augmented products. Understanding the needs of the consumers is only feasible through analyzing their data, transforming them to information to be exploited in the context of relevant strategies. Since data analysis and generation is more reliable and easily available than ever (Griffin, Hwan, Lee, & Guttentag, 2017), the needed circumstances for the data keepers and the end users are set towards completing the shift of the sector.

2.3.1   Challenges of the shift

The relevant literature argues that an unstable and unequal shift is observed. The supplier centered, B2B (business to business) or B2C (business to customer) business model is shaken by hyper scale platforms (Chui & Manyika, 2015), like in the case of Airbnb presented above. Such platforms, exploit sharing economy models (Oskam & Boswijk, 2016) client centric operations, dynamic pricing and adaptive responses (Grèzes & Perruchoud, 2014). Along with the appearance of these new business models, these advancements has blended the traditional on-line and off-line players, in the distribution and advertising "games" (Law et al., 2014) with the Gatekeepers, whose dominance on data aggressively impacts the industry. These, new rules and the new alphabet of digitization, scale and complexity of networks challenge the conventional e-travel management (Chui & Manyika, 2015). The necessity to follow the pace of innovation in the transformation of tourism business model is pragmatic, yet many companies, reluctantly fall back (Irudeen & Samaraweera, 2013), widening even more the competition gap.

2.3.2   The disruptive factors

As the analysis of the key players and the state of tourism indicates a strong disruption, we are scoping further on the disruptive factors. According to the definition of "Euro-monitor's International Analysis", the disruptive factors, also known as "mega-trends", propagate the "long term shift in behavior or attitude with global impact across multiple industries" (Boumphrey & Brehmer, 2017). Under this definition, the global framework is characterized by five disruptive factors: Shifting economic Power, Technology, Population change, Environmental shifts and pressures and changing values.

A report, commissioned by "Amadeus" IT Group, examines the future disruptive factors that could emerge in tourism industry. The report have based its outcomes on

interviews launched within industry's experts. According to this, five major disruptive factors in tourism were identified (Floater & Mackie, 2016):

a. Consumer growth and consumer expectations. Growing population create new markets as new travelers expectations' are shaped while consumers are "trained" from other industries, like entertainment and retail, to a recommendation-led experience (Ashari et al., 2014), frictionless purchasing, inspirational shopping and personalized services (Bock, n.d.).

b. Mobile devices and m-tourism continues to grow, supporting experiential travel and content co-creation, to disrupt travel behavior and spending patterns (Liang et al., 2017).

c. Big data and Artificial Intelligence along with system's efficiency and computing power, allow for real-time analysis of preferences (Ashari et al., 2014) and intelligent merchandizing (Irudeen & Samaraweera, 2013) disrupts the operations and networks of tourism.

d. Regulation, referring to the rules governing the level of data collection and manipulation, will definitely disrupt the status quo and balance of current powers.

e. Travel risk that emerges from socio-economic factors and politics disrupts unpredictably consumer behavior and travel distribution.

3 Systematic literature review on Artificial Intelligence and Tourism

We have chosen to focus our paper on one of the disruptive factors of tourism industry: "Artificial Intelligence". Our systematic review, is the first review in the field scoping from a data driven perspective down to Artificial Intelligence (AI) trying to exhibit its full impact on tourism and will, hopefully, set the basis for future researches.

3.1 Scope and methodological approach

For our study we followed the "systematic literature review" approach introduced by Siddaway, (2014). Our basic aim is to have a structured methodology presented objectively and with transparency as well as in a replicable form that could allow future researchers to update our conclusions. More closely, the steps we have followed, indicated by the relevant approach are:

1. Search terms definition

2. Select sources (digital libraries) to conduct the search

3. Application of search terms on sources and

4. Selection of primary studies by application of inclusion and exclusion criteria on search results.

3.1.1 Search strategy

The below electronic libraries where selected according to their potential relevance in Computer Science and Business management:

– ACM Digital Library

– Springer

– Science Direct

– IFITT Database

In addition to the selected publications, there has been a use of publications that are referenced and cited in the selected ones. Those publications were individually selected

due to the high relevance appeared from their title. Regarding the electronic libraries, their majority is oriented in ICT with the addition of the online database on the International Federation for Information Technologies in Travel and Tourism (IFITT) which was also considered as "The leading independent global community for the discussion, exchange and development of knowledge about the use and impact of new ICT especially in the travel and tourism industry".

3.1.2 Research questions

To establish the research questions, was an essential part in our research both in guiding the review process and also setting its structure.

The goal of this survey is to review and analyze published articles (academic papers and dissertations) in the literature of "Computing Science" and "Business Science" that will lead us to findings that could identify the effect of AI in the specific domain of tourism industry. The paper is addressed to the academic audience and the various stakeholders, whether business or organizations, of tourism sector. Consequently, our research questions would be as following:

"How AI can affect tourism industry?"

To analyze deeper we created the below sup-questions, subtracted from the initial – yet query:

1. What is the value that AI creates across tourism industry?

2. What challenges is tourism facing towards AI?

3.1.3 Research Items

To result in our search terms as below (Table 2), we have made all the possible combinations between our research items in the tourism and the technological domain (Table 1):

Table 1 Search items by domain

Tourism's Domain	*Technology's Domain*
Tourism	Artificial intelligence

Travel	Robotics
Hotel	Neural networks
Aviation	Semantic web
Travel agency	Machine learning
Hospitality	
Tourist	

The combination of the above two columns of search items, provided us with the following search terms:

Table 2 Search terms

"tourism artificial intelligence";	"aviation neural networks";
"travel artificial intelligence";	"travel neural networks";
"hotel artificial intelligence";	"hospitality neural networks";
"aviation artificial intelligence";	"tourist neural networks
"travel agency artificial intelligence";	"tourism semantic web";
"hospitality artificial intelligence";	"travel semantic web";
"tourist artificial intelligence	"hotel semantic web";
"tourism robotics";	"aviation semantic web";
"travel robotics";	"travel semantic web";
"hotel robotics";	"hospitality semantic web";
"aviation robotics";	"tourist semantic web
"travel agency robotics";	"tourism machine learning";
"hospitality robotics";	"travel machine learning";
"tourist robotics	"hotel machine learning";
"tourism neural networks";	"aviation machine learning";
"travel neural networks";	"travel machine learning";
"hotel neural networks";	"hospitality machine learning";
	"tourist machine learning"

To connect the terms and focus our search we used the "AND" Boolean operator. In order to retrieve the maximum number of relevant publications we decided to conduct the search on the title and abstract of the possible publications.

3.1.4   Study Selection

Following, we defined the below criteria to help us decide on the final selection. The following inclusion criteria gave us the primary publications:

I1. A study that focuses on tourism and artificial intelligence; and

I2. A study that describes AI applications, methods or techniques in any field of tourism sector.

Any publications that were addressed to the below criteria were excluded from the review:

E1. A study that only mentions some of the search terms, but does not focus on tourism or AI

E2. A study that focuses on ICT in general (not limited to AI); and

E3. A study that describes AI applications from a technological perspective (programming, algorithms etc.) were tourism is only the sample domain (providing the datasets).

Exceptionally, we selected some of those studies (included in E3 criteria) that discussed their motivation for the domain is a way that promoted our research.

The primary studies that eventually were selected, summarize the below characteristics: met the above inclusion and exclusion criteria, were published or indexed prior to October 2017 and were written in English (language). There were some cases of duplicate appearance of publications across the selected databases that were eventually removed, after the merging of the results. After this initial process, we gathered 230 publications. Those publications were thoroughly read from the title, abstract and full text. At each step not relevant publications were removed. More specifically, we have the following reductions: Title scanning and evaluation, resulted in 158 publications, Abstract reading and evaluation resulted in 120 publications and finally the full text read-

ing and evaluation according to the inclusion and exclusion criteria provided us with our final set of 86 publications.

3.2   The AI Concept

We have already met AI as one of the major disruptive factors in tourism, yet we haven't defined the term AI. To proceed with more confidence in our research, we give following some basic terms and definitions of the concepts that enroll AI. A historic review is also presented and the question of AI adoption in our daily lives and even more specifically in tourism, is also stated.

3.2.1   AI Definition

AI generally refers to "the ability of machines to exhibit human like intelligence such as, problem solving – thus without the use of hand-coded software containing detailed instructions" (Talwar & Koury, 2017). According to Wikipedia, "AI is categorized to the following 4 types":

a) "Weak AI or narrow: A non-sentient machine intelligence, typically focused on a narrow task"

b) "Strong AI – (hypothetical): Sentient machine with consciousness and mind"

c) "Artificial general intelligence (AGI) – (hypothetical): Machine with the ability to apply intelligence to any problem, rather than just one specific problem"

d) "Superintelligence – (hypothetical): Artificial intelligence far surpassing that of the brightest and most gifted human minds"

According to the same definition, AI is "a group of data-driven methodologies" which includes as its components:

a) "artificial neural networks"

b) "genetic algorithms"

c) "fuzzy logic"

d) "probabilistic belief networks"

e) "machine learning"

In the literature we found many approaches trying to define AI. Since there is not a strict definition available, we choose to present a holistic approach that is illustrated in the book "Artificial Intelligence A Modern Approach" ("Artificial Intelligence A

Modern Approach (3rd Edition)," 2010) which presents eight definitions of AI, expand in a two dimensional matrix. The approach is depicted below, in Table 3.

"Artificial Intelligence A Modern Approach" presents the definitions on top that concern the "thinking" processes and the "reasoning", while those on the bottom adhere in behavior. Historically, all four approaches:

a) "Thinking humanly"

b) "Thinking rationally"

c) "Acting humanly"

d) "Acting rationally"

have been followed, in one way or another with various methodologies among various people and scientific approaches (eg the human-centered approach or rationalist approach)

Table 3. Definitions of artificial intelligence, organized into four categories

Thinking Humanly	*Thinking Rationally*
"The exciting new effort to make computers think machines with minds, in the full and literal sense." (Haugeland, 1985) "The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	*Acting Rationally*
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole et al., 1998) "AI ...is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

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3.2.2   AI Historic Review

We see that AI concerns scientists more than 60 years now, the early years 1952-1969 of AI have been reported as success, given the limited resources ("Artificial Intelligence A Modern Approach" (3rd Edition), 2010). Those periods, limited if not archaic, as the book implies, computers and programming tools and the perspective that computers where only of a restrictive use for doing arithmetic's, gave a sense of success in even small steps of perceived intelligence.

A "dose of reality" followed (1966–1973) where scientist made futuristic prediction about the capabilities of computers, the quote by Herbert Simon summarizes the era "It is not my aim to surprise or shock you—but the simplest way I can summarize is to say that there are now machines that think, that learn and that create. Moreover, their ability to do these things is going to increase rapidly until—in a visible future—the range of problems they can handle will be coextensive with the range to which the human mind has been applied."

These not shy visions helped AI to come upfront away from the controversial back-stage, AI becomes an industry (1980) when "the first successful commercial expert system, R1, began operation at the Digital Equipment Corporation" (McDermott, 1982). The commercialization continued and by 1989, considerably nearly every major American Corporation had its own AI group and was either using or investigating expert systems while the birth of neural networks (1986) caused great excitements.

In 1987 AI adopts the scientific method, revolutionizing both the content and the methodology of work in AI. It is now more common to build on past theories than to propose new ones. As a result of these developments, the so called "data mining" technology has gave birth to a new industry.

The AI from a few million industry in the 80's, was booming to billions of dollars in 90's, while many companies were building expert systems, vision systems, robots and specialized AI software and hardware. Relatively soon after the boom, came the period called "AI winter" (summarized by the funding decrease in AI R & D) in which many companies failed to deliver on extravagant promises.

After the goals of Alan Turin and the discourage of AI winter researchers have also started to look at the "whole agent" problem once again, encouraged by the progress they had in technology and in solving sub-problems. Around 1995, intelligent agents

appears on the Internet. AI systems have become common in Web-based applications and words as the "-bot" has entered everyday language. AI technologies underlie in many other Internet tools, such as "search engines", "recommender systems", and "Web site aggregators". AI has been drawn into much closer contact with control theory and economics, that also deal with agents.

3.2.3   AI Technologies and applications today

The promises of artificial intelligence are generous, are growing and also keep expectations very high (Bollier & Firestone, 2010). AI, which allow computers to exhibit human-like comprehension, can now, among others, understand human language, drive cars and increase productivity (in both a personal and corporate level). On the other hand, there is a rather dark area of AI exhibited by media, mentioning privacy dangers starting from "spying" on our personal lives reaching corporate espionage and "dehumanization".

For a better understanding of AI we use the published, in 2017, list for AI technologies based on "Forrester's" Report analysis (TechRadar Artificial Intelligence Technologies, Q1 2017) and below we present our briefer selection:

"Natural Language Generation: Producing text from computer data. Currently used in customer service, report generation, and summarizing business intelligence insights. Sample vendors: "Attivio", "Automated Insights", "Cambridge Semantics", "Digital Reasoning", "Lucidworks", "Narrative Science"."

"Speech Recognition: Transcribe and transform human speech into format useful for computer applications. Currently used in interactive voice response systems and mobile applications. An example from customer service can be United Airlines which provides to its customers the entire conversation for booking a flight guided by an automated speech recognition and dialog management system. Sample vendors: "NICE", "Nuance Communications", "OpenText", "Verint Systems"."

"Virtual Agents: from simple chatbots to advanced systems that can network with humans. Currently used in customer service and support and as a smart home manager. Sample vendors: "Amazon", "Apple", "Artificial Solutions", "Assist AI", "Creative Virtual", "Google", "IBM", "IPsoft", "Microsoft", "Satisfi"."

"Machine Learning Platforms: Providing algorithms, APIs, development and training toolkits, data, as well as computing power to design, train, and deploy models into ap-

plications, processes, and other machines. Currently used in a wide range of enterprise applications, mostly involving prediction or classification. Sample vendors: "Amazon", "Fractal Analytics", "Google", "H2O.ai", "Microsoft", "SAS", "Skytree"."

Some concepts as depicted above; group AI technologies by basic functionality, such as "text", "speech", or "image" recognition. Other approaches, group them by business applications such as "transportation", "commerce" or "cybersecurity".

3.2.4   AI Adoption

The above technologies apply in a numerous of application and target a variety of optimizations along a product's production and commercialization. The benefit is certain, yet the adoption rate is relatively low disputing the prominent possibilities that the media present. Forrester's report ("TechRadar Artificial Intelligence Technologies", 2016) tries to identify some of the obstacles to AI adoption. According to, the relevant survey of "TechRadar", Figure2, companies that asserted their lack in AI investing, claimed: by a 42% that "there is no defined business case", by a 39% that "it is not clear what AI can be used for", by a 33% that "they don't have the required skills" and by a 29% that "needs first to invest in modernizing their data management platform".

"You indicated that your organization is not ready or has no plans to invest in AI. What do you feel is needed before investing?"
(Please select up to three)

There is no defined business case for AI investment	42%
We are unclear what AI can be used for in our business	39%
We do not have the skills to build and support an AI system	33%
We need to invest in modernizing our data management platform first	29%
We do not have the budget	23%
We are unsure what is needed to build or roll out an AI system	19%
We do not feel AI systems are proven	14%
We do not have the right processes and governance	13%
It is a lot of hype with little substance or new ideas	11%
We do not have or have access to the data we would need	8%
Other	6%
I am confused by AI; not sure what it means	3%

Figure 2 Business plans for investment in AI

Source: Forrester's Q2 2016 Global State of Artificial Intelligence Online Survey

Beyond the business side as exhibited by Forester's report, we found and consider AI investment another indicative factor for the adoption level. There is a significant increase of investment in the numerous startups that are acquired, mainly from internet giants. In this direction, few firms have deployed AI or incorporated them into their value chains at scale, while adoption apart from the tech sector is still on experimental stage. Commercial and regulatory considerations, can explain why many companies may be reluctant to act, as the report after all supports that there are rather few business cases that use at scale or in their core of their operations any form of AI technology.

In Figure 3, below we present AI adoption across the value chain of 13 industries, from the McKinsey's report for :AI Adoption and use" relevant survey (Chui & Manyika, 2015).

AI adoption is occurring faster in more digitized sectors and across the value chain

Relatively low ▢▢▢ Relatively high

	Overall AI index	MGI Digitization Index[1]	Assets			Usage						Labor	
			Depth of AI technologies	AI spend	Supporting digital assets	Product development	Operations	Supply chain and distribution	Customer experience	Financial and general management	Workforce management	Exposure to AI in workforce	AI resources per worker
High tech and telecommunications													
Automotive and assembly													
Financial services													
Resources and utilities													
Media and entertainment													
Consumer packaged goods													
Transportation and logistics													
Retail													
Education													
Professional services													
Health care													
Building materials and construction													
Travel and tourism													

1 The MGI Digitization Index is GDP weighted average of Europe and United States. See Appendix B for full list of metrics and explanation of methodology.

SOURCE: McKinsey Global Institute AI adoption and use survey; *Digital Europe: Pushing the frontier, capturing the benefits*, McKinsey Global Institute, June 2016; *Digital America: A tale of the haves and have-mores*, McKinsey Global Institute, December 2015; McKinsey Global Institute analysis

Figure 3 AI Adoption across 13 industries (Source McKinsey Global Institute Report 2015)

The pattern of adoption that describes any new wave of technology is expected and underlined. The pattern suggests early and late adopters, with the phenomenon itself expected to accelerate as well, across time.

Early adopters appear to be the high-tech and telecommunications industries along with automotive and financial institutions (e.g. banks, insurance companies). Those industries present a relatively high adoption in each of their core operations (usage) with an in-depth AI implementation and investment on their assets along with a significant progress in AI exposure in workforce. Less digitized industries including "Resources and Utilities", "Personal and Professional Services", "Building materials and Construction" (except for some parts of the professional services industry and large construction companies) appear somewhere in the middle of the Figure 3.

Towards the bottom of the adoption figure, we find commonly less digitized fields such as "Education", "Health Care" and "Tourism". Despite the progress of those sectors and the extensive publicity on the issue, the opportunities of the "cutting-edge" AI technologies haven't been proved yet (Talwar & Koury, 2017). In fact the reality in adoption remains slow, low and disappointing while it becomes evident, that the weaker adoption is reflected by more challenges. Such challenges as witnessed in the tourism sector, who appears to be last in the adoption issue, could be the fragmentation within the industry. The paradox is that the acknowledgement of the AI potentials exists, particularly in reducing costs and optimize customer experience and it is yet clear to the big players of tourism, however smaller firms have not yet identified their place in the race of adoption.

3.2.5   AI adoption in tourism

Following we comment on the adoption that AI presents in tourism industry and we briefly present some application and use cases we collected.

3.2.5.1 The adoption and demand

The Mckinsey's report we used above, states that the adoption of AI in tourism sector is relatively low, compared to the other selected sectors and according to the investment flows and the given penetration. The overall usage appears to be rather weak, but is necessary to comment that AI spent, workforce management, customer experience and operations and product development appears "greener" fields on Figure. 3 above - which states a growing tension on those fields. Even though, tourism sector is at the bottom of the table it doesn't fall behind greatly from the other sectors who appear higher on Figure 3. If we have a closer look to the late adopters we will find Education, Professional services, Health care, Building Materials and constructions. With the exception of "AI spend" that appears in education the other sectors illustrate a similar image of a "blur" adoption as tourism in the same comparative fields.

The differentiate factor of tourism across the late adopters, is the increased demand that it is observed. The sign that pushed us to scope on tourism was indeed the demand and the opportunity gap that it is revealed. The Figure 4. demonstrates tourism in the fourth place in the AI demand right after the leading sectors. This gap between the

growing demand and yet low adoption is what motivated us further to try to capture and explain this paradox.

Future AI demand trajectory¹
Average estimated % change in AI spending, next 3 years, weighted by firm size²
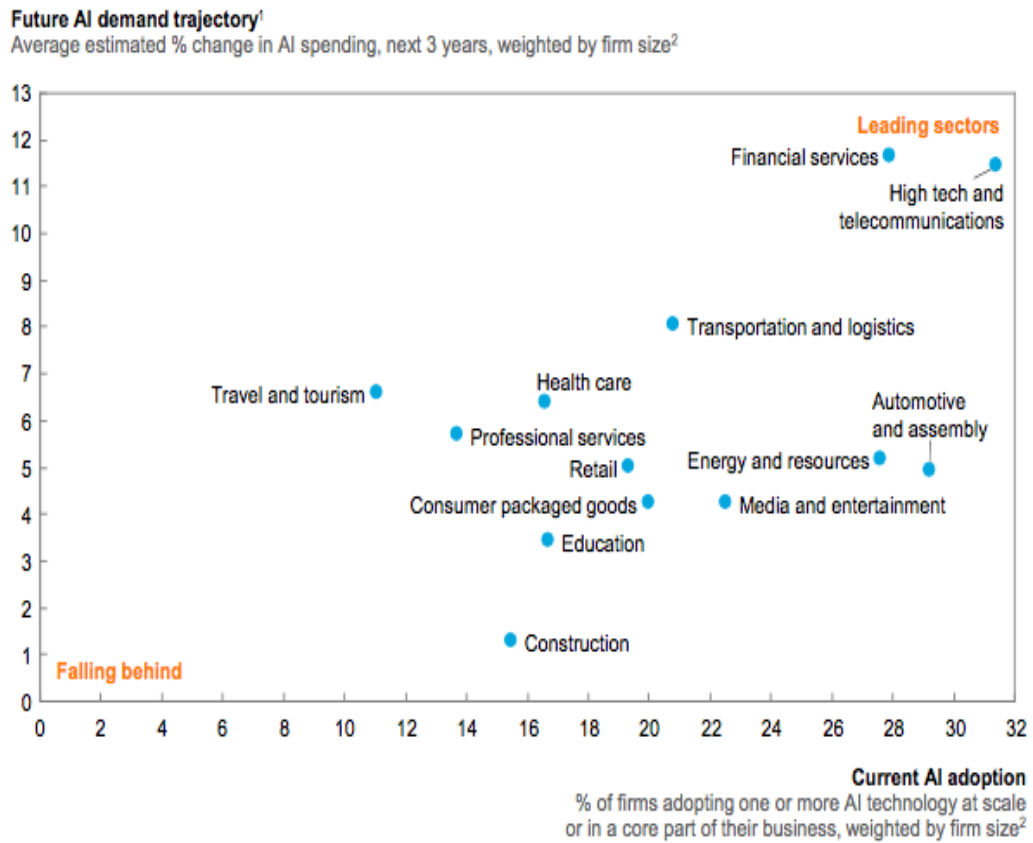
Figure 4. AI current adoption and future demand

Source McKinsey Report AI adoption and use strategy 2016

3.2.5.2 AI applications in tourism

An AI wave in tourism is already observed in travel, initiating on 2016 and as it is forecasted it will get more mainstream in 2017. Most of the applications is used to offer dramatically better recommendations and handle more customers per hour than normal travel agents (Floater, G., & Mackie, L. 2016). To give a more comprehensive content in this position, below we present current use cases of AI in the field of tourism we collected from various reports and publications:

Search process

One major case that tourism sector utilizes AI is the search process. Travel agencies, hotels and various other travel brands include AI technologies in the search process in order to suggest the optimal solution for its customers. The process is well known, yet the ability to search and check millions of options, for a good hotel or a Chinese restaurant in Paris is now a matter of seconds (Skift, 2016). This "speed of light", as many refer to the search speed, is possible over AI sophisticated technologies e.g. machine-learning and neural networks that enables search engines to crawl data and most importantly "learn" how to bring more legit and suitable results at the same time. "Visit Orlando" is tourism board that implemented on 2016 such AI technologies to optimize its search results. The outcome after the implementation was increased both in the efficiency of the board in responding compel travel searches and also in the quality of the responses. "Big Player" have also adopt in their search process "intelligent" technologies. "Facebook" develops the "DeepText" AI engine to compete in the travel search while "Booking.com" has already launched a pilot platform that utilizes AI which give the opportunity to travelers to search more efficient within the company's app.

Recommendations

Data-driven recommendation tools that can recommend alternative travel dates, destinations and local sightseeing options based on your search queries. Recommendation tools are widely adopted by OTA's. Google Flights, for example, with 'Date Tips' suggest cheaper travel times and cheaper airports based on the selected destination. Kayak, among many others, provides a map view of an area that displays prices of hotels as well as 'popular area' views (Lisack J. 2017).

Dynamic Pricing

Hotels change room pricing many times every day based on different variables in the market, to drive more direct bookings and stay competitive. The price change is utilizing AI technologies that use data such as pricing, occupancy, room type, weather, user booking pattern etc. A worth noting example is Starwood Hotels, who spent $50 million over three years to develop an analytics engine to automatically alter hotel pricing rates on the fly The technology has improved demand forecasting by 20% since 2015 (Clint Boulton, 2016).

Chat platforms

"Chat platforms" is another use case of AI that travel businesses have embedded in their online contact with its customers. Such platforms can improve customer service and customer engagement. "Lola" app introduced in 2016 is such a case that utilizes both AI chat functions while it also augments the capabilities of live staff in travel agencies, a combination of mortar and immortal agent.

Driverless Travel

The 3D-printed driverless "Olli" is a minibus manned by a robotic driver and it is scheduled to drive and tour around city streets in Washington, Miami, and Las Vegas. In that extent, today's airplanes are already built to basically fly themselves, using a mixture of auto-piloting and manual controls. The mix of human versus machine control differentiate across destinations. Autonomous planes could save airlines billions per year, however a UBS report showed that "only 17% of travelers are willing to fly without a pilot" (Kathleen Villaluz, 2017)

Actual Robots

Robots in the tourism industry are being tested at the current being. In the market robots can have a posotion as hotel concierge assistants, baggage checkers at airports or bartenders on cruise ships. In fact there is the case of Hilton Worldwide that launched "Connie" in 2016 (Hilton, 2016). Connie is robot concierge that use Watson and WayBlazer's domain knowledge and provides hotel customers with information on tourist attractions, local dining recommendations, and hotel amenities and services. "Pepper" is another robot assistance in the Oakland Airport, "Pepper" greets travelers in Terminal and offers recommendations (Oakland Airport, 2016).

4 Results of the Systematic Literature review – AI impact in Tourism

In order to give some context to our review, we are using an already stated concept of McKinsey Global Institute (MGI) Analysis on Artificial Intelligence "The next Digital Frontier (Talwar & Koury, 2017a). The McKinsey's report, aims to examine AI investment and aims to exhibit the potentials of AI as a megatrend and the next disruptive factor of our era. The MGI's paper, uses five industry case studies to present these potentials. The chosen sectors of McKinsey report, range from labor intensive industries to asset heavy ones, to name some: "retail", "electric utilities", "manufacturing", and "health care"; and involve a blend of private and public buinesses or orgaznizations. We choose to adapt this conceptual matrix to our research on tourism and present the extracted articles of our systematic literature review according to this categorization.

4.1 AI value creation in tourism

The McKinsey's Global Institute Analysis categorize the ways in which AI may create value in four areas:

1. "Project: enabling companies to better project and forecast to anticipate demand, optimize R&D, and improve sourcing"

2. "Produce: increasing companies' ability to produce goods and services at lower cost and higher quality"

3. "Promote: helping promote offerings at the right price, with the right message, and to the right target customers" and

4. "Provide: allowing them to provide rich, personal, and convenient user experiences"

The Table 4. below, illustrates the Conceptual Matrix of AI Value creation in tourism as it is extracted from our systematic literature review. The Table presents 76 articles that we include to this concept, after the selection process and the manual scanning. Following the table we present our results in detail. The resulted articles are presented in the logical sequence according to the series of their appearance per category. Some articles are included in more than one category.

Articles	Year	Project			Produce			Promote			Provide		
		Forecasting tourism flow & demand	Forecasting loyalty	Forecasting Revenue	Automation	Robotics	Augmented personnel & processes	Right price	Right Target	Right Message	Richer user experience	Tailored user Experience	Convenient user experience
Qian, Han, & Haiyan, (2016)	2016	x											
Shahrabi, Hadavandi, & Asadi, (2013)	2013	x											
C. H. Wang, (2004)	2004	x											
Du, Guo, & Wang, (2007)	2007	x											
Law, Mok, & Goh, (2007)	2007	x											
Karapistolis, & Vafeiadis, (2015)	2015	x											
Cho, (2003)	2003	x											
Coshall & Charlesworth, (2011)	2011	x											
Li, Pan, Law, & Huang, (2017)	2017	x		x									
Xu, Law, & Wu, (2007).	2007	x											
Xiao et al., (2014)	2014	x											
Y. Wang, Chan, & Ngai, (2012)	2012	x										x	
Hsu, Shih, Huang, Lin, & Lin, (2009)	2009		x										
Noh, Lee, & Lee (2014)	2014			x				x					
Hashemi, Ghadampour, & Neill, (2010)	2010			x									
Farrington, et al (1999)	1999			x									
Alzua-Sorzabal, Zurutuza, Rebón, & Gerrikagoitia, (2015)	2015				x								
Miranda et al., (2011)	2011				x								
Silva, Neto, & Ibert, (2007)	2007				x								
Berger, Dittenbach, & Merkl, (2003)	2003				x				x				
Schurr, Picciano, & Marecki, 2014	2014				x								
Persing & Ng, (2009)	2009				x								
Cardonha, Herrmann, & Avegliano, (2013)	2013				x								
Murphy, Hofacker, & Gretzel, (2016)	2016					x							
Pan, Okada, Uchiyama, & Suzuki, 2015	2015					x							
Touretzky, 2010; Vaussard et al., 2014	2014					x							
Alexis, (2017)	2017					x							x
Sheffield, 2016).	2016					x							
Ruokangas & Mengshoel, (2001)	2001						x						
Segond, et al (2005)	2005						x						
Chung, & Chiu, (2013)	2013						x						
Oliveira & Si, (2007)	2007							x					
Xu et al., (2007)	2007							x					
Pommeranz et al., (2008)	2008							x					
Camacho, Borrajo, & Molina, (2001)	2001							x					
Thovex & Trichet, (2013)	2013								x				
Beer, Fuchs, Hopken ', Rasinger, & Werthner, (2006)	2006								x	x			
Palao, Castillo, Fdez-Olivares, & García, (2011)	2011								x				
Marrese-Taylor, Velasquez, & Bravo-Marquez, (2013)	2013								x				
Neidhardt, Schuster, Seyfang, & Werthner, (2014)	2014								x				
Hao, Yu, Law, & Fong, (2015)	2015								x				
Logesh, et al (2017	2017								x				
Büyüközkan & Ergün, (2011)	2011								x			x	
Nilashi, M.,et al (2015)	2015								x			x	
García-Crespo, et al. (2011)	2011								x				
Traub, M., et al . (2014)	2014								x				
Almeida, A., Coelho, B., & Martins, C. (2010)	2010								x				
Cranmer, Jung, Claudia, & Dieck, (2015)	2015									x			
Rezola, A., et al (2015).	2015									x			
Cabanas-Abascal et al, (2013)	2013									x			
Ninaus, (2012)	2012									x			
Y. Wang et al., (2012)	2012									x			
Pliakos & Kotropoulos, (2014)	2014									x			
Bustos, Lopez, Julion, & Rebollo, (2009)	2009									x			
Cipolla Ficarra, (2011)	2011										x		
Okura, Kanbara, & Yokoya, (2012)	2012										x		
Weerasinghe et al., 2016	2016										x		
Perez-Valle, Aguirrezabal, & Sagasti, 2012)	2016										x		
Tavčar, Antonya, & Butila, 2016	2016										x		
Berger et al., 2007	2007										x		
Pereira, Silva, Abreu, & Pinho, 2014	2014										x		
Bogdanovych, Berger, Simofp, & Sierra, 2014	2014										x		
Edwards & Griffin, 2013	2013										x		
Linaza, García, Torre, & Torres, (2008)	2008										x		
Martínez, Rodríguez, & Espinilla, (2009)	2009											x	
Ji et al., (2015)	2015											x	
García-Crespo et al., (2011)	2011											x	
Traub et al., (2014)	2014											x	
Ciobanica, Tudic, & Slavescu, (2012)	2012											x	
Srisuwan & Srivihok, (2008)	2008											x	
De Carolis, Novielli, Plantamura, & Gentile, (2009)	2009												x
Hinze & Quan, (2009)	2009												x
Cao & Schniederjans, (2006)	2006												x
KLM's Spencer, SITA's Leo, 2014)	2014												x

Table 4. Conceptual Matrix (1): AI Value Creation across tourism

4.1.1 Project

The first category in which AI can create value is to project actual and real time forecasting that will eventually drive and shape business strategies. The use cases here, are focusing on prediction. Forecasting tourism flow is a vital process to the tourism development and planning that can potentially maximize revenues and optimize involved process like sourcing and supply procurement. AI enables the most efficient predictions of flows using historic data. The literature examines a variety of AI technologies and tools through research and experiments that attribute value to the tourism industry in total, empowering destination management and reinforcing players, such as hotels and airlines, with enhanced decisions and augmented analytics.

4.1.1.1 Forecasting tourism flow and demand

Forecasts can assist, tourism industry into making strategic business decisions and both, individuals into making a travel decision. Qian, Han, & Haiyan, (2016) study depicts the process of modeling tourists' travel, using a hybrid model that combine statistic with neural network with the target to improve forecasting accuracy. As well Shahrabi, Hadavandi, & Asadi, (2013) with the same aim for accurate tools, present a new hybrid intelligent model that is called "Modular Genetic-Fuzzy Forecasting System" (MGFFS) by a combination of genetic fuzzy expert systems and data preprocessing. The paper by C. H. Wang, (2004) is also experimenting on predicting tourism demand using fuzzy time series and hybrid grey theory.

Forecasting particularly in hotel industry, is one way for hotels to maximize their revenues through yield management. Yielding is an optimization in room rate that is driven from the demand of the market and the occupancy/availability of the hotel at a certain period of time, the prediction of the room occupancy rate made by neural network as shown in the paper Du, Guo, & Wang, (2007) is of the same importance as the prediction on the customers' demand that also searched by Law, Mok, & Goh, (2007). Support to the decision process through forecasting, is also described on Stalidis, Karapistolis, & Vafeiadis, (2015) study, where advanced data analytics, neural networks and knowledge representation technologies blend towards an intelligent information system for destination management and marketing. The increased demand for quality services at competitive prices is pushing scientists to optimize the performance of cur-

rent AI tools. The paper by Cho, (2003) investigates the application of three time-series forecasting techniques, namely "exponential smoothing", "the univariate ARIMA", and "Elman's Model of Artificial Neural Networks (ANN)", for travel demand prediction (i.e. the number of arrivals) in the specific destination of Hong Kong. Predicting in particular international tourism demand using AI is the scope of three more articles of our research, the papers of Coshall & Charlesworth, (2011), and Li, Pan, Law, & Huang, (2017) and Xu, Law, & Wu, (2007). Aviation is also another field of research, the paper by Xiao et al., (2014) proposes a hybrid approach, that uses "singular spectrum analysis (SSA)", "adaptive-network-based fuzzy inference system (ANFIS)" and "Improved particle swarm optimization (IPSO)", for short-term air passenger traffic prediction. Y. Wang, Chan, & Ngai, 2012 which overall illustrates a demographic recommender system shows, that demographic information can be used as well, to predict ratings on tourist attractions, enhancing the brand identity of a destination or a business.

4.1.1.2 Forecasting loyalty

"Neural networks (BPN)", "classification" and "regression trees (CART)" for 10-fold cross-validation as described in Hsu, Shih, Huang, Lin, & Lin, (2009) is used for predicting tourism loyalty through identifying the characteristics of attracting customers (e.g. customer service, timely responses) implement them in a service platform and in this way switch customers into repeaters and eventually loyal. Predict tourist's loyalty level can be the key for the operation and profitability of hotels and resorts.

4.1.1.3 Forecasting Revenue

Revenue management is another core process for tourism businesses' strategies, which enables them to predict possible financial challenges and opportunities. Establishing an optimum model for revenue-forecasting customized to travel agencies, is examined in Li et al., 2017 the study uses an "artificial neural network (ANN)" to establish an operating revenue forecasting model. Its outcomes, provide travel agents with an optimized thus more efficient references for actual operations, sales and flows. In the same context Noh, Lee, & Lee (2014), examines the hotel-specific determinants of strategic revenue management. Forecasting models can empower business decisions and reinforce research and development (R&D) and sourcing, reveling both future targets and the way to achieve them. Under this scope we found two very focused articles, the

first is by Hashemi, Ghadampour, & Neill, (2010), a paper that describes the prediction of beach profile evolution utilizing AI and the second by Farrington, Nembhard, Sturrock, Evans, & Schumacher, (1999) which evaluate the dependability of a proposed flight schedule prior to the implementation of the schedule.

4.1.2   Produce

Another area where AI can help create value is production, AI adds values to the production chain where the transforming of inputs into outputs occurs, whether those are products or services (hospitality, travel packages). AI increase companies' ability to produce at lower cost and higher quality. We cluster our articles in this topic in four further categories in the area of a) automation, b) robotics and c) augmented personnel and d) augmented operations. Both c) and d) resulting by the mixture of AI technologies and business processes.

4.1.2.1 Automation

Distribution of the touristic product is a case which AI automation quantify the efficiency of the communication and distributions channels (B2B platforms, web sites, RFP's). In this field we found the paper by Alzua-Sorzabal, Zurutuza, Rebón, & Gerrikagoitia, (2015) paper which examines a prototype system to verify the efficiency of a web site, utilizing AI, and presents the result in a ranking list that enables the analysis of variables that should influence the user's experience.

Most of the times the variety and the volume of tourism's data, makes the manual data indexing of online services very complex. The collection, categorization and presentation of tourism products online, in the most efficient way, is another utilization of AI. Towards this direction the paper by Miranda et al., (2011) presents a prototype, for hotels' services, developed to automatically extract knowledge from tourism-related natural language texts..

AI automation, accelerate tasks and outcomes also in the field of e-commerce reach. The publication by Silva, Neto, & Ibert, (2007) illustrates exactly how this can be achieved through automated negotiation of a virtual travel agent. The focus of the proposed environment, is to give support for the development of computational negotiating agents that may act in a flexible way into a dynamic negotiation. The outcomes of this

virtual negotiation, as also appear in the paper by Berger, Dittenbach, & Merkl, (2003) are timely and at the same time improved in their quality.

In the sector of commercial aviation and traffic control, optimizing processes and reinforcing efficiency and safety via AI is illustrated in the paper by Schurr, Picciano, & Marecki, 2014. The paper presents AI automations and systems offerings that allow function allocation to become more dynamic and adjustable to demands and constraints of diverse situations. This decision aid adjustable performance that guide the human operator reduce errors and cut operational costs.

AI brings great potential for quality improvements by reducing errors; a particular example of such a case is presented in the paper of Persing & Ng, (2009) which describes the classification of incident reports in the aviation domain. Tourism has a very complex backstage environment, with many tasks than need to be harmonically tuned. A good example of such complexity, is the assignment of touristic itineraries. Cardonha, Herrmann, & Avegliano, (2013) is expressing this problematic from the time schedules of a trip to the over-flooding attractions due to timing. "Integrated Route Planning Problem" (IRPP) as it is presented in the relevant publication, is challenging from the computational aspect mainly. The paper presents a mathematical programming formulation adressing the problem and discuss aspects of a solution method based on the "column generation" technique.

4.1.2.2 Robotics

According to the literature review of Murphy, Hofacker, & Gretzel, (2016) on the field, it is evident that robotics will challenge businesses to unify robots into an already composite system of employees, customers, suppliers and information technologies. The paper express a wide range of utilization of robotics in tourism from industrial robots in the back of the house (integrated in intelligent algorithms) to service robots in the front of the house and underlines the importance of human-robot interaction. The identyfied categories are:

a) "industrial"

b) "professional service"

c) "personal service"

The paper demonstrates some exampbe of robotis that is used in tourism, such us: robotic information agents found in a Japanese hotel (Pan, Okada, Uchiyama, & Suzuki, 2015) and robotic housekeepers (Eide, Fuglsang, & Sundbo, 2017); (Touretzky, 2010; Vaussard et al., 2014). The paper describes such cases, and argues that robots vary in mobility, interaction and autonomy.

R-tourism is the term for utilizing robotics in tourism introduced in the relevant paper of Alexis, (2017). This paper also presents the potential applications and value of robotics, in this paper we found:

a) chat-bots and robotic assistance devices

b) virtual receptionists,

c) holographic consultants, (such cooks and bartenders)

According to the paper, robotic technologies promote service augmentation, particularly, chat bots and virtual receptionist appear supportive to humans' skills and knowledge by infiltrating online communication between customers and intermediaries. In the tourism field those technologies enabling users to interact with digital assistants, using natural language to answer travel-related inquiries and process bookings and reservations. (Sheffield, 2016). According to Sheffield (2016), the so-called 'Travel-Bots' can be categorized as:

a) Customer-service Bots: Usually incorporated in the provider's website and their functions are limited to answering basic questions and assisting the user with navigating through the homepage.

b) AI Bots: such applications still rely on instant messaging to interface with the customer.

Despite that the identified value of chat bots and virtual assistance services enhance eventually the customer services and experience, we choose to categorize them in the topic of production, and this way keep them closer to the robotic part of our study as we acknowledge that, primary, it is a business decision to enroll robots in the production chain.

4.1.2.3 Augmented personnel

Augmenting humans' capabilities throuugh AI is a significant facilitaror of productivity and efficiency. Apart from the automations (robotic or not) that could potentially substitute daily tasks (automated negotiation), AI tools can assist employees

accelerate tasks in daily operations. The augmented self is a case of study again in avia-tion, the paper of Ruokangas & Mengshoel, (2001) illustrates effective user interfaces for aviation weather data, minimizing procedure time and complexity. Again here AI is used via "a formation filtering concepts based on a unified Bayesian network model, integrating text and graphical weather data in the context of specific mission, equipment and personal profiles" (Ruokangas & Mengshoel, 2001).

4.1.2.4 Digitalized augmented processes

The training of employees is a process that requires time and effort from the indus-try, the demanding customer service particularly in the entry level of an employ or even in luxury services demanding environment can be also optimized utilizing AI. The pa-per by Segond, Parmentier Roberta Stock, Rosner, Aviv, & gdt Sevilla, (2005) presents an enhanced on-line pedagogical content for language learning in tourism through virtu-al reality practice. Augmented learning processes are also proposed by Tseng, Huang, Liu, Chung, & Chiu, (2013) through an application of the "VR 3D-panorama" technol-ogy on the specific training of cultural tour guiding.

4.1.3   Promote

The third area "Promote" refers to the value creation of AI in tourism trough the promotion of well-priced, well-targeted marketing proposals.

4.1.3.1 Right price via intelligent price management

Intelligent price management can overcome the challenge to set the right price in re-lation to time on the distribution channels of tourism products that is either a travel package by an on-line tour operator or even on a web site of a hotel. AI can drive price elasticity for every item and automatically adjust it, according to the chosen marketing strategy.

Strategic revenue management (than involves pricing and availability parameters) has an interdisciplinary nature that along with the plethora of data attracts the interest of airlines and hotels for AI. The study by Noh, Lee, & Lee, (2016) explored the effects of hotel-specific factors on idiosyncratic price variables. Results suggest that factors e.g. age, brand affiliation, number of competitors, as well as location significantly affect strategic revenue management decisions of hotels and yield consistent pricing power

and improved performance. The study analyses the hotel-specific determinants of strategic revenue management.

Maximizing the customer satisfaction and increased revenues is among others, the added value of pricing management. The objective of the travel agent (mortar or not) is to maximize the total satisfaction of its clients. The paper by Oliveira & Si, (2007) summarizes algorithms, techniques and heuristics used by the AI agents and comments on their performance. The paper makes a unique note that the reviewed agents cannot only rely on complex and efficient algorithms, but also should consider economic issues, marked trends and competition.

Apart from the intelligent algorithms it is crucial to identify the customers' tension and will to pay for a particular product or service. Price sensitivity plays an important role, in engancing new customers, promoting sales and decrease churn rates, however machine learning may assist in marketing strategies while it can be used for determining which customers are the most profitable. The paper by Xu et al., (2007) makes an attempt to create a data mining approach on behavioral pattern specifically in regards to tourist expenditure.

Pricing is affected by the forces of supply and demand. The process that brings those two together is negotiation. Price negotiation is a case that can be automated by AI since again it can save resources. The same rules apply to the automated negotiation as if it was between a client and a sales person in a hotel or a travel agency. The golden rule for an optimal agreement is that both party's preferences have to be taken into account and both parties should be satisfy after the negotiation. Intelligent systems during a negotiation process is the field of study by Pommeranz et al., (2008) In this concept of suggesting, planning and negotiating a trip is experimenting the paper by Camacho, Borrajo, & Molina, (2001), presenting a multi-agent approach to travel planning in a dynamic environment that could interact with changing information and use planning processes to find the problem solution.

4.1.3.2 Right Target

AI offers a variety of models and opportunities to capture the consumer preferences and identify market's trends. The study by Thovex & Trichet, (2013) defines "a model and a decision support system for semantic analysis of social networks embedding networks of opinions". The model is helping in governance and in the identification of fu-

ture touristic products and services, so as to cherish the rise of economy. In the same context CAIPS by Beer, Fuchs, Hopken, Rasinger, & Werthner, (2006) discusses push services and their potential to boost the overall objective to use mobile information systems that already operate in tourism and could also leverage B2C communication by opening a new smart channel. These channels optimize the communication by focusing on the needs of customers minimizing time and effort, which is translate in efficiency and profit. Apart from companies, destinations can also benefit from optimized tourist targeting Palao, Castillo, Fdez-Olivares, & García, (2011) present in their paper the "Smart-tourism Project" in which cities can offer customized and personalized tourist experiences to every visitor, identifying their needs by making use of open data platforms along with AI utilization. "A new alternative to discover consumer preferences about tourism products, particularly hotels and restaurants, using opinions available on the Web as reviews" is presented by Marrese-Taylor, Velasquez, & Bravo-Marquez, (2013) using aspect-based opinion mining technique and natural language mining. The literature, identifies and underlines the importance of understanding user's intentions from information retrieval systems in the particular field. Berger et al., (2003) demonstrates "how a fuzzy search strategy, performed by a constrained spreading activation algorithm, yields beneficial results and recommends closely related matches to users' queries."

In addition, literature argues, that extracting information to capture and model user preferences, particularly in the field of tourism, is a hard problem. The initial profiling becomes harder since consumer themselves, are often not conscious or sure enough to even express their needs. In the paper by Neidhardt, Schuster, Seyfang, & Werthner, (2014) the basics of a picture-based approach are introduced. The paper aims at revealing implicitly given user preferences by mapping travel related pictures that conclude to a specific traveler's profile. In the same direction Hao, Yu, Law, & Fong, (2015) present a design-science research paradigm, for developing a genetic algorithm-based learning approach to understand customer satisfaction and their psychologic reasons.

Collaborative filtering has been widely used to make similarity-based predictions for the recommendation of the relevant list of items to the users Logesh, Subramaniyaswamy, Vijayakumar, Gao, & Indragandhi, (2017) experiment in their paper, with a novel user clustering approach based on Quantum-behaved Particle Swarm Optimization (QPSO) proposed for the collaborative filtering based recommender sys-

tem. The proposed recommendation approach has been actually evaluated on real-world large-scale datasets of Yelp and TripAdvisor. Büyüközkan & Ergün, (2011) also proposes" "an intelligent system which works as a recommendation tool for trip planning by using case based reasoning algorithm" by recommending users the most available trip alternatives by comparing archive cases with the new client. Another hybrid method for hotel recommendation, using "dimensionality reduction" and "prediction techniques", is proposed by Nilashi, M., Bin Ibrahim, O., Ithnin, N., & Sarmin, N. H. Nilashi, Bin Ibrahim, Ithnin, & Sarmin, (2015) and attempts to address the same issue. Staying in the hotel industry, García-Crespo, Á., López-Cuadrado, J. L., Colomo-Palacios, R., González-Carrasco, I., & Ruiz-Mezcua, B. (2011) present a semantic hotel recommendation expert system, based on the consumer's experience about recommendation provided by the system. Sem-Fit uses the consumer's experience point of view in order to implement fuzzy logic techniques to relating customer and hotel characteristics, represented by means of "domain ontologies" and "affect grids"; García-Crespo, López-Cuadrado, Colomo-Palacios, González-Carrasco, & Ruiz-Mezcua, (2011) as well as Traub, M., Kowald, D., Lacic, E., Schoen, P., Supp, G., & Lex, E. (2014) present another scalable hotel recommender system specially made for "TripRebel". Similarly, Almeida, A., Coelho, B., & Martins, C. (2010) present in their paper, an artificial intelligence-based architecture to be used in various tourism services, namely "the user modeling and recommender system components". Through the use of several machine learning techniques, such as "linear models", "neural networks", "classification" and even "text mining", a hybrid and complete approach at understanding tourism application users is accomplished.

4.1.3.3 Right Message

Return to costumer's the right message is the key to sales, profitability and loyalty. The paper by Beer et al., (2006) presents the CAIPS (Context Aware Information Push Service), "a service designed to meet customer's requirements, by offering an intelligent mechanism for actively providing personalized information to tourists depending on their context and location". The project is focused in understanding the user's location and behavior on a set of artificial environment that is built in order to describe best, user's context. "The tourism sector started to comprehend the opportunities of overlaying digital content onto tourists' real environment" (Cranmer, Jung, Claudia, & Dieck, 2015), as the relevant study by Cranmer, Jung, Claudia, & Dieck (2015) has found: "AR

can add value to Manchester Jewish Museum as considered the way to move forward, to preserve history, enhance visitor satisfaction, generate positive word-of-mouth, attract new target markets as well as contribute to a positive learning experience". The use of proper advertisements, to each visitor may increase "Click Through Rates" (CTR) and rates of conversion, AI can ensure this, as argued in the paper by Rezola, A., Gutierrez, A., & Linaza, M. T. Rezola, Gutierrez, & Linaza, (2015). The paper presents a novel online advertising approach for automatic "persistent personalization" of Web ads, on the basis of Web-mining techniques that combine representative parameters for advertising in a unique platform. "POST-VIA", introduced by Cabanas-Abascal, Rodríguez-González, Casado-Lumbreras, Fernández-González, & Jiménez-López, (2013) is another information system whose main objective as presented: "is to develop tools to manage direct marketing strategies in the tourism sector. The system offers DMOs a management component of communication and interaction with the customer based on a highly accurate perception of it, allowing individualized marketing campaigns, utilizing AI and semantic Web".

In order to deliver the right message to the right customer, a series of processes need to be considered and optimized. Requirements prioritization is among them, Ninaus, (2012) analyze the impact of preference visibility on the outcome of the requirements prioritization process and propose new heuristics to optimize the quality of the forecast and conclude with an evaluation of the different recommendation heuristics. Y. Wang et al., (2012) in their paper, use different machine learning methods "to produce prediction of ratings, in order to determine whether or not these approaches and demographic information of tourists are suitable for providing recommendations". Search engine retrieval accuracy and automated annotation system is of paramount importance also for recommendation systems. The paper of Pliakos & Kotropoulos, (2014) propose a method of: "simultaneous image clustering, classification and annotation tested on a dataset of 30.000 images bearing text information (e.g., title, tags) collected from Flickr and achieving a top rank precision of 80% for tourism recommendation". In this direction researches the paper by Bustos, Lopez, Julion, & Rebollo, (2009) which presents: "a tourism recommender system architecture, applying trust concepts to create relevant and good quality personalized recommendations trying to solve the tourist Recommender systems issues".

4.1.4   Provide

"Provide" is the fourth area in which AI can create value. This area is customer service, and AI hels by providing an enhanced user experience by creating new sources and channels of value to form it richer, customized, and more user friendly.

4.1.4.1 Richer user experience

In this direction, there has been a lot of research in order to enhance user experience. Virtual reality (VR) has the leading role among AI technologies. Cipolla Ficarra, (2011) makes a comparative analysis among use cases of VR and present "a state of the art of the human-computer interaction aimed at tourism and cultural heritage in some cities of the European Mediterranean". Another case the VR adds value to tourism and enriches consumers' experience is illustrated in the study by Okura, Kanbara, & Yokoya, (2012). The study develops "an augmented telepresence system which enables virtual tourism beyond time and space". "Virtual Eye", is another case of virtual tourism, the platform is introduced in the paper of Weerasinghe et al., (2016) and it is presented as "a smarter mode of interaction to virtual environments, for the first time in Sri Lankan history". Utilizing the touch of 3D simulation. Unique touring and experience offers also the game-like VR system: "Medieval Vitoria-Gasteiz" which is presented by Perez-Valle, Aguirrezabal, & Sagasti, (2012) and allows visitors to know the history and lifestyle of the village in the 16th century by "simply" playing a game on a virtual village during their real visit to the city. Virtual interfaces are presented also in the paper by Tavčar, Antonya, & Butila, (2016) which adopts personalization benefits and raise customers' interest for visiting cultural sights through a web service for virtual museum tours that is based on intelligent virtual assistants that can learn user preferences and provide recommendations regarding museum programs An augmented environment is also introduced in the paper by Berger et al., (2007) which describes: "an e-Tourism environment that takes a community-driven approach to foster a lively society of travelers who exchange travel experiences, recommend tourism destinations or just listen to catch some interesting gossip". In this case, AI is utilized through a 3D Electronic Institution, "a framework developed and employed in the area of multi-agent systems, to the tourism domain".

Mobile technology has already enriched user experience, "Augmented Reality" (AR) initiates as one of the technologies that can be utilized in a variety of cases including, mobile applications, allowing an even more improved user experience. The paper Pereira, Silva, Abreu, & Pinho, (2014) describes such a tourism-oriented mobile application "to be used in a botanical garden, which uses current mobile device's capabilities to provide the visitor with several ways to obtain the desired information. The results obtained from this application are shown, including images of the implemented features, and highlighting the results related to the use of augmented reality".

Richer near to reality experience may be offered by 3D products, the study by Bogdanovych, Berger, Simofp, & Sierra, (2014) argues that "virtual experience provokes similar impressions as direct experience". Additionally, Edwards & Griffin, (2013) argue that "one of the factors that makes virtual experience even more successful is human curiocity, since people that have not yet been exposed to 3D product presentations may simply be curious to experience it". Virtual reality and computer vision are combined in the next study. The concept of binoculars on hills expecting tourists to put a coin in to see the area around is widely used. The "PRISMA project" by Linaza, García, Torre, & Torres, (2008) presents: "an augmented view of tourist information from a new point of view replacing binoculars with computer vision allowing this way the user to interact with multimedia information". The computerized view, as underlined by the publication, "can increase the interest of tourists in visiting places and help them in choosing further targets to visit later on, providing the relevant information".

4.1.4.2 Tailored user Experience

Martínez, Rodríguez, & Espinilla, (2009) argues in their paper that "recommender systems have become a key tool in marketing processes in e-commerce, because they provide an added value to Web–based applications in order to keep customers". We have indeed, exhibit this part or recommender systems, above in the value creation that references targeting. Adaptive recommendation attempts to address customers by capturing information about what each customer needs according to their created profile is state on the papers of: Ji et al., (2015), Büyüközkan & Ergün, (2011), Nilashi et al., (2015), García-Crespo et al., (2011), Traub et al., (2014). Following this concept, Martínez et al., (2009) introduce a hybrid recommender system for restaurants, collabo-

rative and knowledge-based, that is able to provide recommendations in any required situation by the customers. Ciobanica, Tudic, & Slavescu, (2012) argues that obtaining relevant and trustworthy information is of a great impportance for the success of the travel recommender systems.. The aim of a recommender system as stated in Srisuwan & Srivihok, (2008) is "an ability to correctly filter and analyze customer's preferences and behaviors, to recommend the right information to specific customers in selecting their interesting products or services".

4.1.4.3 Convenient user experience

AI support the user choice as the paper by De Carolis, Novielli, Plantamura, & Gentile, (2009) argues. The paper illustrates how, a mobile recommender system in the Tourism domain "MyMap", creates "comparative descriptions to support decision making about what users should observe, among relevant objects of interest" (De Carolis, Novielli, Plantamura, & Gentile, 2009). This way consumers have more confidence in their decisions, while visiting a foreign destination, with contextual information presentation, information clustering and comparative explanations of places. Recommendation systems apart from a hot topic in R&D in tourism, are also a factor that changes consumers' behavior. Psychological researches have indicated that people are more willing to trust recommendations from people they know or has similar behavior to them. AI can make this process more convenient Hinze & Quan, (2009) present "a trust-based recommendation service for a mobile tourist guide" that uses the notion of directly and indirectly trusted peers. However as Cao & Schniederjans, (2006) paper demonstrates "that most such systems focus mainly on price and avoid important purchasing decision-making factors such as quality and reputation". To help once again the consumer's stake and convenience this paper experiment on a reputation-based architecture for an e-tourism system that is called 'reputation-based electronic tourism' (RET). The experiment created an artificial neural network model for a reputation agent to evaluate capabilities for selecting products in the e-tourism environment. In the cruising field now, we have the appearance of 'Smart-Ships' in the global cruise fleet. The cruise ship, Royal Caribbean's feature a number of smart-features and applications. Such as online check-in, "RFID armbands", "cruise-apps", "virtual balcony-staterooms", and "affordable high-speed internet connectivity on-board" (Alexis, 2017). The paper continues identifying various cases that make a physical trip more convenient. To name a

few, Robotic Assistance Devices (abbr. RADs) are currently being piloted in travel agencies like AMADEUS' Pepper, Hotels like Marriott's Mario and Botlr Robot Butler and Airports (KLM's Spencer, SITA's Leo, 2014).

4.2 AI challenges

The second concept that we have chosen to scope our research is the challenges that are acknowledged by the literature and anticipated around the adoption of AI in tourism. The concept that we categorize our exported articles in order to identify the challenges consist of 4 fields: Technical Challenges, Financial and business challenges, Regulatory Challenges and Socio-ethical Challenges. The concept has transformed as below:

Table 5 Conceptual Matrix AI Challenges (26 articles)

Articles	Year	Technical		Financial & Business		Regulatory	Socioethical		
		Data Silos & Complexoty	Algorytmic Bias	Cost	Business		Labour	Acceptance	Cultular Silos
Walchhofer, et al (2009)	2009	x							
Bustos et al., (2009)	2009	x							
Xiao et al., (2014)	2014	x							
Pliakos & Kotropoulos, (2014)	2014	x							
Gretzel et al., (2015)	2015	x			x				
Cardonha et al., (2013)	2013	x							
Peng & Tzeng, (2012)	2012	x							
Coshall & Charlesworth, (2011)	2011	x							
Y. Wang et al., (2012)	2012	x							
Xu et al., (2007)	2007	x							
Hong, et al 2011	2011	x							
Shahrabi et al., (2013)	2013	x	x						
Camacho et al., (2001)	2001	x							
Nielsen, (2004)	2004	x			x				
Hsu et al., (2009	2009		x						
Walchhofer et al., (2009)	2009		x						
Cranmer et al., (2014.)	2014			x					
Claudia et al (2014)	2014			x					
Alexis, (2017)	2017			x	x		x	x	
Murphy et al., (2016	2016			x				x	
Oliveira & Si, (2007)	2007				x				
Du et al., (2007	2007				x				
Berger et al., 2003)	2003					x		x	
Liu, (2011)	2011					x			
Pan et al., (2015)	2015					x			
Ninaus, 2012	2012								x

4.2.1 Technical Challenges

In this category, we found articles and publications that express the technical challenges there were facing in their efforts to build or implement an AI system.

4.2.1.1 Data Silos and data complexity

Data silos occurs when data is not collected into one place and instead isolated among different systems, compromising market coverage, data quality, and accuracy Walchhofer, Hronský, Pöttler, Baumgartner, & Fröschl, (2009). This is a technical problem that AI systems have to counteract in an overloaded information context (Bustos et al., 2009). Isolated data, collected in various formats (photos, text, videos) among with the hidden input/output data relationship and the possibility of overly excessive computational requirements Xiao et al., (2014) need efficient algorithms for recommendation and annotation (Pliakos & Kotropoulos, 2014). Addressing this challenge, "AI have to present near-real-time, real-world data processing, integrating and sharing using complex analytics, modelling, optimization and visualization to make better operational decisions" (Gretzel et al., 2015). Most of the times proposed algorithms will require extensions Cardonha et al., (2013) or hybrid models, Shahrabi et al., (2013) and Peng & Tzeng, (2012) in order to become satisfactory for large real-world scenarios Coshall & Charlesworth, (2011).

Cold start problem, another data driven challenge, in recommender systems can be relevant both for new users on new products, which has yet no reviews or history to base on a suggestion. To address this problem AI models search for alternative sources of information, for example the proposed system by Y. Wang et al., (2012) categorize the tourists using demographic information and reccomment proposals, based on those demographic classes. The use of such information alone can only drive limited accuracy. Wider sourced and versatile in-puts, such as textual review can enhance recommendation or in the case of forecasting, government policies, weather conditions and national wealth which play an important role in determining tourist arrivals can improve the accuracy of the out-puts (Y. Wang et al., 2012). Although there are quite a lot studies on "hybrid forecasting", new approaches still required in order to improve forecasting performance and decrease the uncertainty of the outputs (Xiao et al., 2014)

According to Xu et al., (2007) paper, "nowadays, knowledge discovery techniques have become important for business organizations to remain competitive in the global

economy. The complexity, noise and nonlinearity in tourism data adds many challenges for existing data mining techniques such as rough sets and neural networks". This position is argued by other publications as well, "With the increase of the complexity and the larger problem scale of tourism demands, genetic algorithms (GAs) are often faced with the problems of premature convergence, slowly reaching the global optimal solution or trapping into a local optimum" (Hong, Dong, Chen, & Wei, 2011). Shahrabi et al., (2013) and Camacho et al., (2001) papers argue the difficulty to develop but also to maintain systems that extract, filter and represent efficiently an indeed reuse this heterogeneity of data that are constantly updated. The challenge here as acknowledged by Nielsen, (2004) is that businesses should agree upon a unified and transparent way of data collection and storage.

4.2.1.2 Algorithmic bias

Algorithmic bias occurs when data used to teach a machine learning system reflects implicit values of humans involved in that data collection, selection, or use (Wikipedia). AI models "need a large amount of historical data in order to yield accurate results" (Shahrabi et al., 2013). The presumed neutrality of AI models is often lost - the bias occurs in terms of explanatory power as the internal machine learning is processed in a "black-box mode in which the internal weights and relationship between variables are unclear or difficult to express in an explicit way which is relevant to real-world problems" (Hsu et al., 2009). We should also take into consideration, since we study the challenges of the data that we will meet the challenges of the internet as well, since it is the main tool of extracting those data. The assumption presented by Walchhofer summarizes those thoughts as below "AI modeling is based on gathered online data and domain semantics and in the assumption that the Web indeed truly maps market developments and consumer's profile (Walchhofer et al., 2009).

4.2.2   Financial and Business Challenges

In this section, we present the business challenges that emerge from AI and summarized in cost concerns, ROI questions and commercial challenges that are blend with organizational flows and networks between stakeholders.

4.2.2.1 Cost of R&D and ROI

According to the present study by Cranmer et al., (2014) "organizations often fear high investments in AI without the proof of concept due to risks of failures. The paper uses a small museum in Manchester to investigate the value of AR for different target markets, visitors and the museum itself to gap opportunities and challenges and eliminate such drawbacks". In the same context Claudia Tom Dieck & Jung, (2014) investigates the value of augmented reality from a business model perspective. The study of Alexis, (2017) as well makes a novel approach to identify the cost of implementation and adoption in the field of robotics. Where it is argued that automation, digitalization and robotics could, at least theoretically, assist in reducing staff costs. In the paticular case of cruise tourism that the paper studies, less crew could be translated to less staff-related costs and more space and cabins for revenue-generating guests, resulting that it is indeed a business decision whether to invest on AI and it is upon each strategies goals. Murphy et al., (2016) also examine the ROI of robotics. The paper states that "industrial robots in the back of the house and service robots in the front of the house have financial effects". It continues by pointing the factors that influence the return. Among them the paper identifies:

a. "capital investments"

b. "expenses"

c. "revenues",

d. "leasing versus buying"

e. "maintenance"

f. "depreciation"

g. "human computer interaction (HRI)"

4.2.2.2 Business Challenges

Tourism is a challenging domain specifically for AI system that cover predictive processes, such as revenue or demand forecasting. The survey by Oliveira & Si, (2007) reveals that, in order to achieve reliable out-puts these AI systems and agents cannot only rely on complex and efficient algorithms, but business oriented issues are also needed to be considered such as crucial economic issues e.g. marginal utility, relationships between supply and demand, and market dynamics. Du et al., (2007) also address-

es the issue and comments that "since prediction efficiency of neural network outperforms those of multiple regression and naïve extrapolation, which shows the feasibility of applying neural network prediction model to Beijing tourism hotel industry their future research will be to include more dependent variables to determine the room occupancy rate prediction efficiency of a neural network". The paper continues that "government policies, weather conditions and national wealth can play an important role in determining tourist arrivals but at the same time those are dynamic factors in a continuous fashion and difficult to provide a commonly acceptable measurement for them".

In addition again, the paper by Alexis, (2017) on Robotics, indicates the so-called 'disintermediation effect', postulated that the potential of ICT technologies and the corresponding reduction of transaction costs, could lead to the emergence of electronic markets for holidays, with the fear of replacing brick-and-mortar tourism intermediaries (i.e. travel agencies and tour operators). Another challenge as acknowledged by Nielsen, (2004) is that businesses need to develop new or hybrid business models that combine commercial as well as sustainability requirement that addresses the disruption of the data and digitization era.

"Smart tourism initiatives around the world are seeking to build viable smart tourism ecosystems" (Gretzel, Filho, Lobianco, Vazquez, & Mistilis,2014) yet the sector's fuzziness and comples networks within it, creates a hard base to surpuss specific innovations. Yet, the paper argues that "tech-push in the direction of smart tourism" is true and it is forecasted that businesses will stay committed and concentrated on the AI values and goals.

4.2.3   Regulatory Challenges

In this category we choose to include the publications that made a reference on the matters on regulation. The main concerns on privacy, individuality and safety are expected to be in some way resolved through regulations.

4.2.3.1 Regulation on Privacy

Since literature is based on the collection and manipulation of data to produce business insights, and argues that AI utilization may increase the willingness of users (Berger et al., 2003) to give away more of their data, than they are able to express by traditional channels. Yet, using those channels and offering private data might hide the

danger of data misuse. This asymmetric gathering of information should be controlled, and as Liu, (2011) states, governments needs to take administrative and legislative means to control the operations of tourism enterprises, as long as, privacy concerns. A problem that we found in Pan et al., (2015) approach is that an AI interface design might not correspond to the way the user is capable of, revealing his preferences creating this way an uncomfortable situation on the user's sense of privacy.

4.2.4   Socio-ethical Challenges

The main social concern in this section includes the fear of job loss. Another major concern from the ethical part of the equation is acceptance on AI in the work flows and daily lives of humans.

4.2.4.1 Unemployment Hazard

Trying to evaluate the return on investment of AI and in particular robotics in the cruise industry the paper by Alexis, (2017) argues among others "that the technological innovation appears to be employed mainly for enhancing the holiday experience and not to replace humans with robots, yet the fear remains". To stand his position Alexis, (2017) demonstrates crew-related costs to be relatively low. Therefore, it could be asserted that a more strategic service interaction could be economically more attractive than saving staff-costs. The paper concludes that "particularly in R-tourism is not solely about replacing humans with robots but it bears the promise to individualise mass-packages and mass-tourism by utilizing efficintly AI". One efficinet way to do so, the paper states, is that to create teams in which humans and intelligent technologies work more productively together.

4.2.4.2 Social Acceptance

The paper by Alexis, (2017) raise awareness into the matter of social acceptance. Social acceptance in the robotic field is translated in the extent that tourists are willing to adopt and interact with robots during their holidays. The paper continues and states that "the main perceived advantages were the robots' ability to handle data, deal with many languages and function non-stop". Main disadvantages included fears of robots being 'too impersonal'or hazardous. The paper highlighted national differences in terms of adoption-readiness, with Chinese (92%) and Brazilian (73%) respondents being the

most comfortable; while European respondents were the least (German -37% and French - 47%).

Another paper that discusses acceptance also refers to robotics, Murphy, J., Hofacker, C. F., & Gretzel, U. (2016) paper states that "robots in charge, could make users feel isolated. Human-robot interfaces should follow familiar social rules and conventions" and another question is been raised: "Do we want to interact with robots as we interact with our next-door neighbour, our colleagues, or with the people who work in our homes?" The paper demonstrats the concept of the ideal robot. That could be machine-like in speed and precision, however, robots should follow social norms and maintain humanly charachteristiscs such as empathy, while avoiding mistakes and biases. On the other hand, humans paradoxically might be impolite with robots and that should also raise awareness if we consider that robots indeed is an input and output devise that present results according to its inputs.

According to Berger et al., (2007) "even though the number of online sales of tourism products is increasing, people still appreciate social interaction with travel agents, their expertise and to receive help with impulse decisions". On the other, hand the paper, considers "that sophisticated visualization of tourism products and services along with the consulting role of travel agents and the social interaction and information exchange between travelers, all incorporated infront of the information richness of the Internet will be the key features for successful e-Business in tourism".

4.2.4.3 Cultural Data Silos

Cultural data silos, may result in isolation of data, yet at this cases, the isolation occurs form a cultural base and not a technical. Since corporate differentiation is based on data (Ninaus, 2012) this information is difficult to be retrieved especially in a high competitive industry, such tourism, many times data stay often "locked" into businesses, as they considered intellectual property (and in order to avoid corporate espionage), resulting in data silos, as presented above in the technical challenges.

5 Contribution – Discussion

This systematic literature review, presents an authentic academic research in the domain of tourism. The researched fields of value creation and challenges that emerge from the impact of AI in tourism is a unique approach with no history in the academic literature.

The paradox that we observed, which is summarized between a data driven industry, such tourism and a rather limited tech-mentality, pushed us further, to investigate the environment of the industry, the potential and the eventual impact of new technologies in the future of the industry. Progressing our research, we reached at a point that mega-tech trends seem to shape and disrupt the current state of tourism. Focusing on those disruptive factors AI, appeared, distinctively, among the others as the most undiscovered field. The reasons that we chose to scope and limit our tourism interest around AI are three main disciplines: demand, timing and the opportunity for success. Market researches show that there is an increased demand for intelligent solutions in tourism, while the timing is perfect since AI have been developed and already been used among leading industries and companies. These shape the perfect opportunity for shifting tourism to follow good practices, adopting the AI mentality and evolve within the data era into a profitable and sustainable industry.

Our systematic literature review is methodologically guided to address both research questions. The systematic review of 86 studies both in the business and technical scientific fields, presents the value creation of AI across tourism which emerges from the current use cases and research cases of AI in the domain of tourism. Many opportunities for further research can arise, for scientist who wish to explore AI use in tourism, as well as plenty ideas for implementation and adoption are presented for entrepreneurs that wish to enroll their tourism businesses into high technologies.

Through our review of the wide range of articles we have extracted the gist of the value creation and the challenges of AI across tourism. Most of the articles state an apparent connection between AI technologies and particular areas (business models, product portfolios, R&D, customer segments, production, marketing, human resources, and go-to-market) within a business strategy of tourism players. The majority of the articles were motivated to use and experiment in the domain of tourism, using industry's data to

develop, evaluate, optimize and even compare AI systems and models. There are also some articles that attempt as well to identify the value creation of particular AI technologies, such as robotics and augmented reality in particular cases of tourism such as various museums around the world. In addition, we have some articles that focus on particular processes of tourism businesses e.g. hotel revenue forecasting or flight scheduling which try to optimize the current technologies utilizing AI.

The vast majority of the presented articles are routed and as a conscience, oriented towards the scientific field of Computer Science, ICT, informatics and mathematics. The rest, minority articles are sourced in the business part of E-commerce and Tourism. This created an opportunity for us to present a business oriented approach of the topic. The evidence show that there is a lot of interest in AI, with twice as many articles mentioned AI in the literature from 2014 to 2017 as in the previous years.

5.1 The value creation of AI in tourism

The major contribution of our research is the discussion about the value creation of AI in tourism. Our findings are summarized in the increased efficiency, productivity and profitability that AI can create to tourism businesses and at the same time the extreme personalized, convenient and rich experience that can provide to the consumers.

Analyzing further our findings the majority of the writers initiate their studies from the dynamic performance of tourism industry and its potential for further growth utilizing AI technologies. To categorize our findings we used a categorization based on the McKinsey's report (Chui & Manyika, 2015) and further scoped into particular areas of value creation that adjust into the case of tourism. We observe that the two first categories "Project" and "Promote" address to the inner operation of a business and the value they gain from AI while the other two "Promote" and "Provide" illustrate the value that the consumers of industry receive as result.

To help in visualization of our findings we build the "AI value Creation in tourism" pie, which illustrates proportionally (Figure 4) the articles' appearance per category in our literature. The greenish colors represent the wider category of "Project", the blue colors the "Produce", the yellow colors the "Promote" and the reddish color the last category of "Provide". The visualization help us to identify the distinctive cases of the *Projection of Forecasting demand,* of *Promoting the Right target* and *Providing Richer us-*

er experience who have collected the bigger number of publications within our review, underlying the current direction of interest and efforts of the academic community.
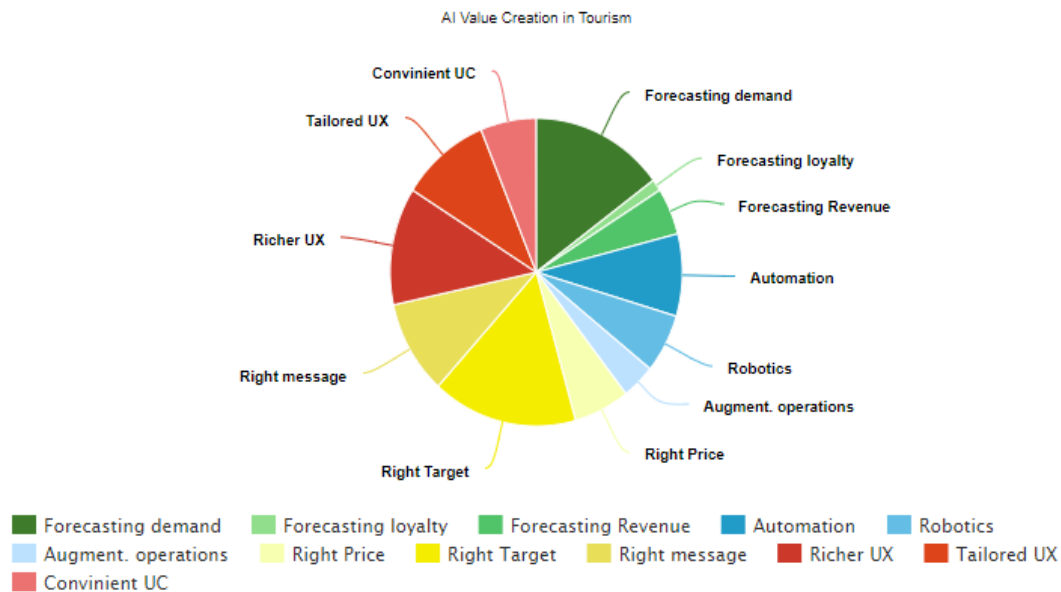

Figure 4. AI value creation in tourism

5.1.1 Project

Focusing on the first category of our concept on value creation, we conclude that the identified articles in this category, are clustering in three main topics, forecasting, optimization of business knowledge and strategic planning, each of them address to operation driven by business. Forecasting is the proses of prediction performance using historic data, our literature found three cases of forecasting inside tourism industry that utilize AI. That is forecasting:

a) Tourism flows and demand

b) Loyalty

c) Revenue

Sophisticated algorithms and systems capable of processing a multitude of structured and unstructured data are used to predict tourist demand, consumers' loyalty, rating on attractions, business performance and revenues. The differentiate factor of those technologies from the other approaches (analytics, statistics) is their responsive and efficient nature. AI processes real time data on real time producing the most accurate results. The offered value is indeed the projection of timely business insights, and it is recognized on the provision of business management and especially in internal operations such as procurement, supply chain, human resources, sales and marketing strate-

gies, research and development. In this way AI re-organizes more efficiently business operations enhancing or even driving strategic decisions, reduce costs pressures (by inaccurate programming) and maximize revenues and overall profitability.

5.1.2   Produce

In these category the articles demonstrate a value that it is created through:

a) Automation

b) Robotics

c) Augmented personnel

d) Digitalized-augmented processes

Through AI technologies, production is continually optimizing its assets and automate business processes. We have present here, studies that quantify the efficiency of digital appearance on tourism products (e.g. in a hotel's web site), studies that examined AI models that speed up time of daily processes via automation, such as the on-line tourism package negotiation or AI systems that allow automated adjustable performances of processes that reduce errors (e.g. in aviation). Many studies illustrate the use cases of robotics in the production chain and customer service, arguing that most efficient way to integrate them, literature agrees, is creating the best teams of people and robots. Automation, robotics and augmented operational environment are the factors that create the added value in production by improving quality and reliability. Automation on core processes of tourism business via the use of chat bots or virtual agents, in customer services and distribution of travel services can accelerate tasks quantify the e-commerce reach and maximize conversions and overall productivity. Apart from the on-line presence, automation and robotics that utilize AI solutions augment human skills and performance by reinforcing their physical strength (e.g. to carry luggage) or quantify their knowledge by providing for example timely information or proposing several action scenarios to choose among. It's important to underlie here that the key to higher productivity lies on the selection of the most fitted AI solution upon each business needs.

5.1.3   Promote

In this section of our literature review we collected the articles that were relevant to the promotion and marketing of tourism services and products. The studies that were categorized further into three categories of promoting:

a) The right price

b) To the right target

c) With the right message.

In brief, our findings here include AI systems that sets the optimal price to the costumer, according to their ability to identify automatically customer's buying intensions. There were also introduced intelligent systems that plan and negotiate a trip in a dynamic environment maximizing results and sales. The added value is acknowledged by the increased customer satisfaction which in return increase loyalty to a business and consequently revenues. In addition, optimizing the communication channels with customers utilizing for example natural language mining, minimizes time and efforts again increasing the profit margin to businesses. Focusing and understanding customers' needs AI applications (embedded in recommendations systems) can return the right and most relevant marketing message to the most eligible (or even profitable depending on the goals of every business) customers. This optimized promotion add to the brand identity of a business and most importantly keeps its customers satisfied thus returning.

5.1.4 Provide

The last area of value creation that was identified by the review of our literature is the illustrated within customer experience. AI technologies and researched systems allow tourism players to provide rich, personal, and convenient user experiences to their customers. The most import clue to this added value, is that it primary covers the exponential increase of such amplified experiences that consumers are seeking. This trend for new, exciting, easy-to-share experiences is already identified in the tourism market and we have in detailed presented in our customers' analysis in our chapter for Tourism and its major players (2.2.2.). AI enables businesses to address to this trend and satisfy their customers, a step further. Making customers feel special and welcomed, is one way to foster loyalty and increase consumption and sales, AI technologies like "computer vision", "virtual reality" and "machine learning", as our literature review indicates, can open new forms of experiences via new means of excitement. AI systems can offer travel experiences to many more people and create custom benefits that address to each of those consumers individually, tailoring their travel services upon identified need, better than ever before.

According to the identified values we conclude that AI could create a competitive advantage to every business or player of the tourism industry as a whole while implementing AI. We consider that AI will mostly disrupt and shape the supply side of the chain, with shifts in business models and profits in the long-run in efficiency and productivity. Transportation and communication costs will be decreased, new markets (niche markets, new destinations, new tourism activities enhanced by AI) will open and drive economic growth (Talwar & Koury, 2017a) at a more sustainable environment (Fudo, Matsumoto, Kashima, & Akiyoshi, 2014). Efficiency and productivity will be potentially assisted by the optimized forecasted demand, the targeted promotion and flawless delivery of services. AI can be an important part of marketing and content as, for example, companies with their chatbots, virtual assistants or robots (García-castro, 2017) will be able to learn the traveler's preferences more specifically (Samdantsoodol, Cang, Yu, & Tumur-Ochir, n.d.) and optimize the engagement in the digital world and provide more sophisticated products in the real world to strengthen loyalty and branding.

5.2 AI Challenges

At this point is crucial to identify the challenges with the aim to surpass them in order to maximize the end value of the AI role in tourism. To make the presentation and the analysis of the challenges in developing and adopting AI in the tourism field we decided to categorize the challenges to a conceptual matrix we have created that presents the articles on: Technical Challenges, Financial and business challenges, Regulatory Challenges and Socio-ethical Challenges.

5.2.1 Technical challenges

Under the first category, Technical challenges, the vast majority of our articles were concentrated on three further topics: a) Data driven challenges, which include data silos and data complexity referring to the challenging retrieval and processing of data. This challenge is initiating from the heterogeneity and noise that tourism data may have along with their sometimes questioned quality and accuracy. b) Algorithmic bias ad-

dresses the challenge that occurs when the data used as inputs reflects to implicit values of humans. The black-box mode that was brought as a challenge, in which machine learning often operates and internal weight and relations of the data remain most of the times unclear put extra consideration to the bias leaving the data processing "unseen" thus probably uncontrolled and difficult for corrections to apply. c) Data standardization is another challenge that was identified with many articles addressing the lack of standards as a main challenge.

5.2.2 Financial and Business challenges

The second category financial and business challenges include two main concepts. The return on investment question that many tourism business have as they fear of high investments in AI without the proof of concept and the need for new or hybrid business models in tourism that combine commercial and sustainable requirements that address to the new era of data and intelligence.

5.2.3 Regulatory challenges

Regulation, out third category is another challenge that concerns greatly businesses and stakeholders. The one article we found in the literature to raise the matter, and we consider this lack due to the mostly technical orientation of our selected articles and not due to the limited importance of the matter, states that governments should take administrative and legal means to regulate the privacy and security of every interested party towards engaging with AI.

5.2.4 Socio-ethical challenges

In the last presented categories, the sociotechnical aspect, we found two other concerns that touch the social aspects of the use of AI in tourism, the first is the concerns around labor and the second is the cultural acceptance, particularly in the case of the most obvious and known to the vast majority, use of AI, robotics. In the case of labor our literature gave us an estimation around the future of tourism employees and robotic utilization, particularly in R- tourism we saw that robotics and intelligent maschine are not solely about replacing humans with robots but the senario is to augment humans abilities. The case in acceptance seems to search for the optimal solution and way for a human computer and human robotic interaction.

Researcing further from our selected literature, regarding labor, as we acknoledge the importnace, we found the review of World Economic Forum's (2017) relevant to the matter. According to this report, intelligent automation will change the nature of some travel jobs and eradicate others. Indicative, within the next 5 years, "Tourism 4.0" related technologies (cloud computing, mobile internet, robotics, artificial intelligence, autonomous vehicles and even 3D-printing) is expected to have a considerable impact on the skillset-requirements, as well as on the composition of the global tourism workforce (World Economic Forum, 2016). The fear of displacement of human workers by machines is more intensive as similar head-cuts have already happened when the industry moved to its internet era in the 90ies. In tourism though, we currently observe a tendency for role replacement and new talents search. New roles emerge such as the Data Analyst's and others extinguish such as the Revenue Manager's. New augmented roles shifts from conventional services to quantified or hybrid as the case of Travel Agents (Xiang & Fesenmaier, 2005) who, now, they are shifting from the bricks and mortar model towards a virtual model (e.g. clicks and mortal). In addition, cognitive abilities and systems-related skills are becoming increasingly vital, within a social-skill-focused tourism education and training.

On the other side, it is again estimated that the digital transformation of the tourism and travel sector implies: $780.000 displaced jobs, mainly front-line functions in airports and hotels, in the hospitality and catering sector (World Economic Forum, 2017) another document also published by McKinsey & Company estimated that 66% of the tasks in travel and hospitality could be automated, which represents 53.9 million jobs worldwide. However AI can have a $305 Billion value-addition for tourism companies, due to productivity and improved capacity utilization, $100 Billion value-migration, from traditional players to new entrants, $700 Billion value-addition to society as a whole, due to end-customer time/money savings and by reducing security related costs.

We conclude our findings acknowledging that debates are around the AI adaption and adoption, the reluctance stand for those fundamental ethical, legal, and regulatory issues that have to be resolved before AI speeds up its business integration. Privacy and data ownership have to be also transparent, safeguarding sensitive data without destroying their mining capacity, so a golden rule is challenging. Common data standards and machine readable data are currently challenging tourism sector, with an absence in specification and standardization (Tourism, 2009) and the vast volume of hard copy operations (e.g. museum ticketing) or non-digitized information.

6 Conclusions and Future Work

Artificial intelligence exists more than 50 years, yet we witness that it is now reaching an increased dynamic, thanks to more powerful computers and the multiplication of available data. Similarly tourism is used in ICT thus the identified value of AI especially, appears augmented by the numerous high performance applications and the perfect correspondence in terms of demand.

To sum up our findings, the value that AI adds on tourism, touches upon suppliers' and costumers' perspective under the umbrella of responsiveness and timing. Starting from the time aspect, and on the absence of an AI leader, in tourism industry, the opportunity of differentiation in the competitive environment is given while early adoption is considered an asset. From the consumers' side who are now the main focus, AI have made possible their customization, the match of personalized services is done on a more targeted in behavior and habits, richer in terms of content, speed, price and value and convenient in terms of the offered tools and time scheduling. AI can exploit the long tail distribution (Chuang et al., 2017) of the available data and provide a higher experience, matching or exceeding consumers expectations with new services for niche needs and new ways of serving existing needs.

AI, being a Megatrend in tourism impacts disruptively the industry. Its implications on consumer's behavior, travel facilitation and governance along with its potential applications, should be thorough analyzed and resolved to integrate harmonically its value, within the industry's present and future. The evaluation of such trends and identification of players have to be regularly monitored and reviewed, as even recent researches may seem outdated, due to competition increases and new ideas. Business need to reinvent their business models and strategies, digital or not, with the objective to stay relevant in the completive environment and to improve service, efficiency, and profitability. Tourism industry, as one of the bigger industries, it delivers as an excellent case of an indus-

try that has transformed itself, in accordance to changes of our era, grasping opportunities to improve its quality.

We consider the identification of AI value creation in tourism, the first step towards a successful AI transformation of the industry. Yet, there are further factors that constitute the successful shift and among them we could find the data ecosystem and the cultural acceptance which we believe that it could be our future work. We would like also to continue our work deepening into, the new business models AI enables and continuously to identify the degree of acceptance among tourism's different players. We would also like to give a more theoretic aspect of the value of AI in tourism, contacting an analysis of Porter's value chain with the identified findings of the present review. Finally, we will return with a literature review in the next three years to capture the evolments of the sector.

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Appendix

Exhibit 1. AI investment
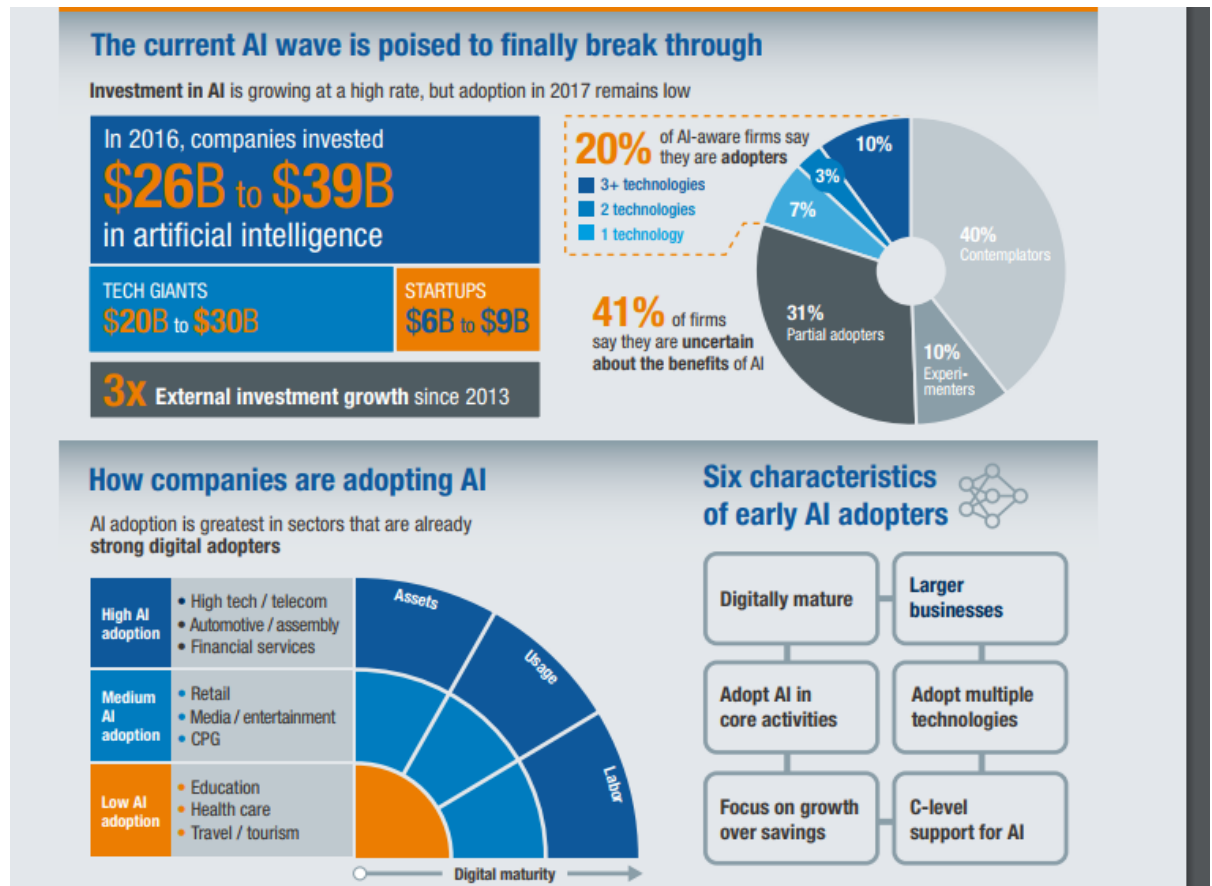
Source: McKinsey Report on AI, 2016

Exibit 2. Countries' sample for the survey on adoption

Source: McKinsey Report on AI, 2016

MGI AI adoption and use survey sample overview

% of respondents (n = 3,073)

Geography		Company size		Sector	
Sweden	5	>10,000	7	Other	12
South Korea	9	5,000–10,000	6	Energy and resources	3
China	10	1,000–5,000	15	Travel and tourism	4
				Automotive and assembly	4
Germany	10	500–1,000	10	Transportation and logistics	4
				Telecommunications	5
Japan	10	250–500	10	Consumer packaged goods	5
				Education	5
Italy	11	50–250	11	Media and entertainment	5
				Financial services	5
Canada	11	10–50	14	Health-care systems and services	7
France	11			Construction	8
United States	11	<10	27	Retail	8
				High tech	10
United Kingdom	12			Professional services	14

NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis