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Artificial Intelligence in the Travel & Tourism industry
Adoption and impact

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Abstract

The following thesis evaluates the current adoption level and shows the potential impact of artificial intelligence systems in the travel and tourism industry. The focus of the work project lies on current AI applications such as chat bots or robots and their usage along the traveler journey. The evaluation of the current adoption is based on a collection of use cases. The impact evaluation is based on expert discussions and opinions. In both cases the results of third party studies are also included. The purpose of the work is to give the management and owners a guidance how to handle artificial intelligence in their travel and tourism business.

Keywords: Artificial Intelligence, Robots, Travel, Tourism, Hospitality, Technology Adoption, Impact Assessment, Chat bots, Travel assistants, recommender systems

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Purpose

Artificial Intelligence (AI) is increasingly becoming a part of everybody's lives. Major everyday applications such as the Google search engine or Amazon's product recommendations already utilize artificial intelligence technology to provide better offerings (Chace 2016; Alpaydin 2016), not to mention the development of self-driving cars (Makridakis 2017). Additionally, recent bestsellers such as Nick Bostrom's 'Superintelligence' (2014), Yuval Noah Harari's 'Homo Deus' (2016), or the TV show 'Black Mirror' helped to catapult artificial intelligence in the mainstream. Furthermore, Gartner, Inc. – a world leading technology advisory company – identified "AI everywhere" as one of the major technology trends for the years to come (Gartner 2017). However, the mentioned sources are mainly concerned about the economic and society system or discuss only selected applications such as legal advisory, medical diagnosis and self-driving cars. But one should not underestimate the importance of artificial intelligence on the travel and tourism industry. Travel and tourism contributes through direct and indirect effects 10.2% to the global gross domestic product (WTTC 2016). It would be unreasonable not to analyze how artificial intelligence is affecting such a big part of the global economy. Especially since Skift, a leading travel media company, identified artificial intelligence as a megatrend for the industry (Skift 2017). This background in mind, the Dutch Federation of Travel Organizations (ANVR) started the travel tomorrow project in 2014. In the first stage the project aimed to answer questions such as 'Which trends will shape the travel industry?', 'What will customers demand?', 'Which business models will prevail?' and delivered answers over the year 2015. In 2017 a second stage was started with a focus on two technologies and their coming role in the travel industry: Blockchain and artificial intelligence. Based on expert group discussions, interviews, and with the support of Roland Berger, a management consultancy, a blue paper was drafted until the 4th December 2017[1] which answers the core research question: What new opportunities and business models do the new technologies

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[1] Available in the extended appendix

blockchain and artificial intelligence offer for the travel industry? Regarding a deep dive about artificial intelligence, the research question was further specified to: How is artificial intelligence currently and in the future impacting the travel industry and what should I do as a travel enterprise about it? The Author of this thesis was an integrated member of the Roland Berger team and especially responsible for the deep dive about artificial intelligence. His task was to scientifically accompany the research and include his findings in the blue paper. However, due to formatting constraints not all findings were included in the blue paper. This thesis presents a top down view about the development of artificial intelligence and the various impact dimensions this technology has on the travel and tourism industry. It shall be used as inspiration and as a guide for further research and business initiatives.

Literature review

The current scientific as well as business literature about artificial intelligence in the travel and tourism industry is comparable shallow. The business literature is limited to opinion sections, descriptions of single examples and short overviews about current and potential use cases. The scientific literature was many years mainly concerned about the utilization of artificial intelligence for forecasting of travel and tourism demand. For example, Burger et al. showed already in 2001 how artificial intelligence can be used to forecast tourism demand in Durban, South Africa (Burger et al. 2001). Since then uncountable tourism demand forecast models, based on artificial intelligence algorithms, have been developed and proved useful (Peng, Song, and Crouch 2014). Besides demand forecasting, recommender systems were another research focus (Borràs, Moreno, and Valls 2014). However, the scientific community did not look deeper in the business applications of neither travel forecast tools nor recommender systems. The utilization of artificial intelligence systems by the travel industry as well as the accompanying costs and benefits were not further discussed. This changed remarkably during the year 2017. Scientific papers were published which took first steps

in answering questions such as 'what are costs and benefits of artificial intelligence systems for travel companies' (Ivanov and Webster 2017) or 'how service robots will be utilized in the hospitality sector' (Murphy, Gretzel, and Hofacker 2017).

Methodology

Two answer the research question about the current and future status of AI in the travel and tourism industry as well as the consequences for the industry, two main methods were chosen. First, a collection of current use cases of AI system in the industry was established, based on desk research and expert recommendations. Second, several discussions and expert interviews were conducted to identify and evaluate impact and consequences for travel and tourism companies. A broader survey about adoption level and the impact of artificial intelligence on the travel and tourism industry was also considered. However, during the first expert meetings it became obvious that the definition of artificial intelligence even strongly differed between the experts. It was thus decided not to conduct the survey since the results would be highly biased by the respective definition of artificial intelligence. Overall, the thesis consists of four main parts. First, a broad introduction about the nature of artificial intelligence. Second, the display of the current adoption of artificial intelligence in the industry, based on third party studies and the use-case collection. Third, a demonstration of the impact of artificial intelligence, based on third party studies and the expert opinions. Fourth, a short look in the future is taken and relevant take-aways are derived.

Definition of the travel and tourism industry

A meanwhile often used definition of travel and tourism systems was developed by Neil Leiper in 1979 and later updated by him in 1990. According to Leiper the phenomenon travel and tourism can be described as a system which is functioning under various environments and influenced by economical, legal, political, and technological developments. Leiper's system consists of three

geographical elements, the tourist generating region, the tourist destination region, and the transit route region. Additionally, two non-geographical elements are included, the tourist and the tourism industry, as depicted in figure 1.
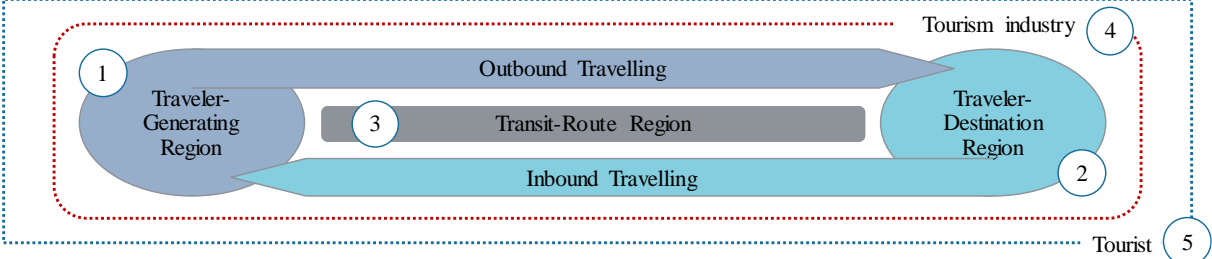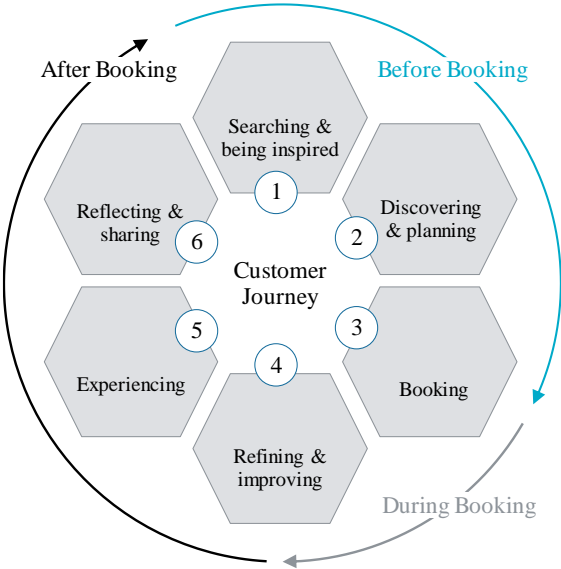

Figure 1: Tourism as a system, Leiper 1990

Figure 2: The customer journey of a tourist, Roland Berger 2016

According to the UNWTO definition, a tourist is a person which travels to a place outside their usual geographic environment for no longer than one year and with an overnight stay[2] (Candela and Figini 2012). However, the industry is not only interested in the traveling stage but in the entire customer journey. According to Roland Berger the customer journey of a tourist, depicted in figure 2, consists of six stages, from searching to sharing.

The tourism industry, however, consists of every organization, either public or private, which is involved in supplying the tourism product to the tourist. This includes but is not limited to intermediaries such as metasearch engines, online travel agencies and brick & mortar agencies as well as inventory providers such as airlines, hotels and cruise lines. Through the emergence of the sharing company even private consumers which provide inventory such as accommodation through peer-to-peer platforms became part of the travel and

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[2] Travelers without an overnight stay are considered visitors

tourism industry. The usual ecosystem which is used by these organizations to sell and supply can be seen in figure 3.
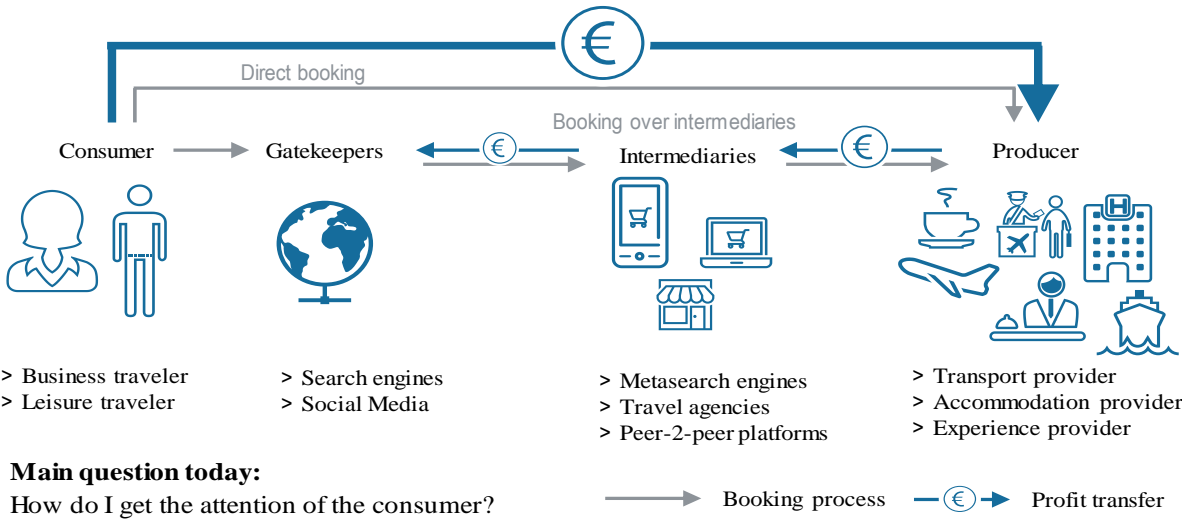

Figure 3: The sales and supply system in the tourism industry today, own illustration

Putting the content of this thesis into perspective of Leiper's system, one can say that this work is dealing with the question of how a specific technological development, namely artificial intelligence, is affecting a specific element of Leiper's tourism system, namely the tourism industry.

Definition of artificial intelligence

Artificial intelligence is known to the computer sciences since the pioneer work of Alan Turing in the 1940s (Copeland 1993). The Dartmouth conference in 1956 finally introduced artificial intelligence as a mainstream topic in many scientific fields (Bostrom 2014; Russell et al. 1995; Copeland 1993). Since then, research in artificial intelligence made a lot of progress. However, up to date there is no general accepted definition of artificial intelligence, mainly because there exists no general definition of intelligence itself (Tegmark 2017; Reed 2006). Nevertheless, there exists a broad understanding that artificial intelligence mimics the cognitive processes of humans, including but not limited to learning, reasoning, perception, and using language (Bostrom 2014; Britannica 2017). However, taken as given that intelligence is the ability to perform these cognitive processes,

it remains unclear which artificial systems are identified as intelligent? Therefore, two different concepts of the determination of artificial intelligence systems which are used throughout the thesis are introduced.

Artificial intelligence as a continuum

How intelligent is a system? This is the basic question of the concept of intelligence as a continuum. As defined by Max Tegmark (2017), intelligence is the ability to accomplish complex goals. And "since ability comes on a spectrum and isn't necessarily an all or nothing treat" (Tegmark 2017) it cannot be said that some system is intelligent and another one is not. It can only be said that one system is less or more intelligent than the other. The important take away is that there exists no certain threshold, which defines a certain system as intelligent. All systems which accomplish a complex goal are in some way intelligent. Following this definition, a family dog shows a certain level of intelligence when it defends the family's property. In the same sense, a calculator shows a certain level of intelligence (Tegmark 2017). The same holds true for a chess computer or a chatbot. The only differences between them are their different goals and the level of intelligence necessary to reach this goal. Artificial intelligence is thus a goal oriented execution of processes by an artificial system, no matter how difficult this process may seem for humans. However, many people would not say that a calculator is intelligent. They usually apply the following concept of artificial intelligence:

Artificial intelligence as a learning system

Is a system intelligent? This is the basic question of the concept of artificial intelligence as a learning system. This kind of concept arises through the so-called "AI-effect." The AI-effect was described by Fred Reed as follows: "A problem that proponents of AI regularly face is this: When we know how a machine does something "intelligent," it ceases to be regarded as intelligent." (Reed 2006). Expert systems for example were a well-known application of artificial intelligence in the 1980s, whereas today many people would not say that expert systems are intelligent (Tegmark 2017). In

this sense, an artificial system is defined as intelligent as soon as it shows a certain threshold of intelligent considered mechanism. Nowadays, this threshold is commonly reached if a system can learn (Alpaydin 2016). This is called machine learning and almost all contemporary artificial intelligence technology is based on machine learning techniques such as Bayesian models, decision trees or neural networks, including deep learning (Alpaydin 2016). On contrast, earlier artificial intelligence systems such as expert systems were almost always symbolic artificial intelligences. This is called "Good Old-Fashioned AI" (Bostrom 2014). In "Good Old-Fashioned AI" almost all necessary states where predicted by a programmer which then pre-programmed every system to react in each state in a certain way; comparable to a set of if-then statements. If a state was not pre-programmed the system broke down. Following this definition, a family dog is intelligent since it can learn that it must not defend the family's property against the postal man. However, a simple calculator is not intelligent since it misses the ability to learn. It is only able to execute the operations which are pre-programmed by human programmers. On the other hand, modern chess computers and chatbots are perceived as intelligent because they learn how to play chess or answer a question. However, this also implicates that an artificial intelligence system, which currently fulfils the threshold to be perceived as intelligent, won't be called intelligent as soon as the threshold moves further. For example, a future threshold for artificial intelligence could be the ability to show emotions or reach more than only one complex goal. A contemporary chatbot has neither of these abilities.

Both concepts about artificial intelligence have obviously their reason for existence, since it cannot be said that the one is objectively wrong or right. However, it must be recognized that the AI-effect is real. Thus, it is assumed in this thesis that contemporary journalistic articles and scientific papers define artificial intelligence according to the current state of the technology. The same holds true for papers of earlier years, in which Artificial intelligent systems greatly differed from contemporary definitions. Almost no work, besides papers about the history, future, and systematic

of artificial intelligence, such as Copeland's Artificial intelligence: A philosophical introduction (1993) defines AI closer or use the continuum concept. In the conducted interviews and expert discussions it was assumed that artificial intelligence systems are currently defined as learning systems. Nevertheless, this paper is also concerned about the future and as it will be seen, especially the continuum concept can be used to make statements about AI systems in the future.

Robots as a kind of artificial intelligent systems

There exist two kinds of AI systems: Pure digital ones such as chatbots and digital-physical hybrids such as self-driving cars. The latter ones are usually called robots. There are different to pure digital systems since they can execute manual as well as cognitive processes. For example, a chess computer can only execute the cognitive process to determine the next moves on a chess board. But it is not able to execute the manual process to move the figures on a physical chess board. Since robots are a hybrid of digital and physical systems, they are sometimes regarded as a special kind and researched apart from artificial intelligence (Ivanov and Webster 2017). Other works instead include robots as a certain kind of artificial intelligence systems (Russell et al. 1995). This thesis follows the second approach and includes robots in its analysis. However, with robots the definition dilemma arises as well. Many would argue that a car assembly robot in the 1970s or '80s was not intelligent, whereas a self-driving car is often considered an artificial intelligence system.

The process behind the intelligence of artificial systems

For a clear understanding of the potential as well as limits of artificial intelligence systems it is important to have at least a rudimentary understanding of how such systems work. Though, according to the concept of artificial intelligence as a continuum there are an abundant number of systems which all work differently. A simple calculator works very different than a recommender system. An AI system in the 1970s worked different than one of 2017. Therefore, the concept of artificial intelligence as a learning system is used to describe the state-of-the-art technology. These

learning systems work basically in four stages as it can be seen in figure 4 (Gandhi and Ehl 2017; Gerbert et al. 2017).
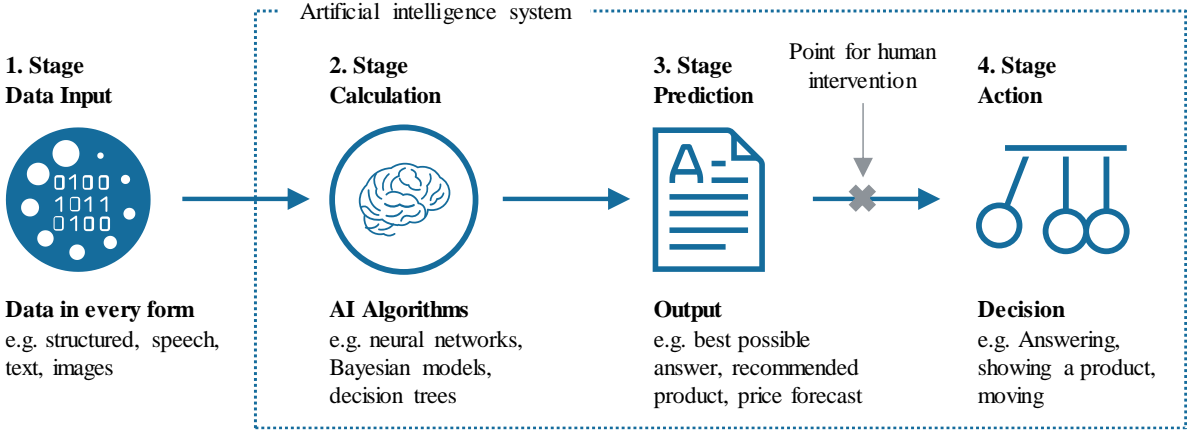

Figure 4: The functioning of a learning system, own illustration

E.g. the input data for a chatbot would be the written entries of an asking customer, the AI algorithm would process these entries and predict, respectively recommend, the best-suited answer. This predicted best answer could be send automatically to the customer or could be forwarded to a human employee who checks the answer again and send it out afterwards. However, how does the AI algorithm know what the best answer to a customer's question is? The answer is learning. The AI algorithm itself learns, based on a set of training data, how to interpret input data and which actions to recommend. In the case of a chatbot this training data could consists of thousands of scripted conversations. This training cannot only be done before the live employment of an AI system but can also be continued during the employment, making the system cleverer with every further usage. There exists plenty of different types of learning methods and AI algorithms such as reinforced learning, respectively neural networks or Bayesian models (Goodfellow, Bengio, and Courville 2016). Summarized it can be said, the more processing power, the better the algorithm and the more data an artificial intelligence system has, the more capable it is.

The intelligence level of artificial systems

Artificial intelligence levels, relevant for the continuum concept since it asks, 'How intelligent is a system?', are commonly classified by two dimensions. First, scope of abilities to reach a goal, and

second, fulfillment level of those abilities; both compared to human level intelligence (Bostrom 2014; Makridakis 2017; Chace 2016). Regarding scope of abilities literature differentiates between artificial narrow intelligence and artificial general intelligence. Narrow intelligence describes a system which can only reach one or very few goals such as playing chess or chat with a customer. General intelligent systems otherwise can reach a broad range of goals (Bostrom 2014; Harari 2016). If compared to human level intelligence, a general intelligent system can thus at least reach every goal a human could reach, including developing scientific theories, recognizing neighbors, or driving a car.

The second dimension is the ability to fulfill the goal. A system can either perform better or worse than a human in reaching a given goal. If a system outperforms a human it is called "super-intelligent" (Bostrom 2014). A renowned example for superintelligence are chess-computers. Since 1997, when IBM's chess computer Deep Blue beat the then World Chess Champion Garry Kasparov (IBM Corporate 2017), digital computers outperform humans in chess and are thus "super-intelligent" in reaching this specific goal (Bostrom 2014). Unfortunately, there exists no common term in the literature for the contrary. In this thesis it is thus called "minor-intelligent". Additionally, a further threshold characterizes this dimension. Since not yet named by the scientific community, it is here called the 'Usability level'. If an artificial intelligence system can fulfill a goal good enough to be employable by an organization, it is usable and thus above the 'usability level'. However, it can still be below the human level and thus minor-intelligent. Chatbots are a common example. Usually they are employed by companies for different reasons but still perform worse than a human agent would do. For a better understanding of this classification scheme the different levels are shown in figure 5.
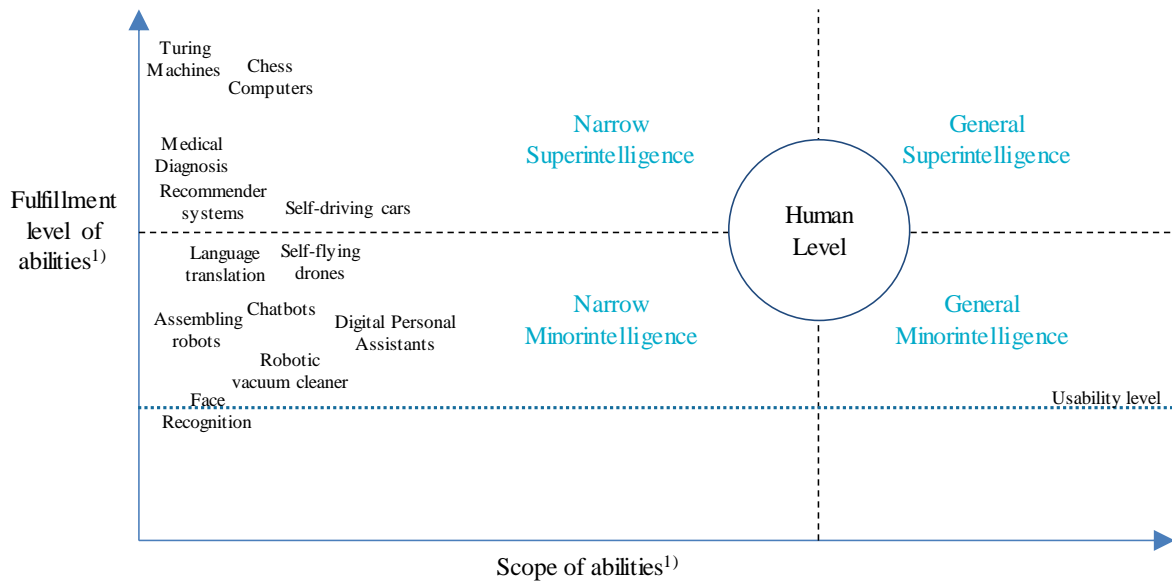
Figure 5: Classification of AI systems according to ability levels, own illustration

Adoption of artificial intelligence in the travel and tourism industry

Overall adoption level

After defining what the travel and tourism industry as well as artificial intelligence systems are, the question arises what the current adoption level of AI systems in this industry is. There is currently only one study published which covers the overall level of AI adoption in the travel industry. According to this recent study by the McKinsey Global Institute (Talwar and Koury 2017) the overall adoption level in travel and tourism is rather low, ranking last place among thirteen different industries. However, while the current adoption is on a low level, the sector is planning to increase its AI-related spending in the coming three years, ranking on the fourth place among the thirteen examined industries (Talwar and Koury 2017).

Current use cases

According to the collected use cases, accumulated figures[3] can be seen in tables 1 and 2, the travel and tourism industry currently employs a wide range of AI systems. However, four patterns were

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[3] Complete list in the extended appendix

identified. First, artificial intelligence systems were preferably used at customer centric applications instead at operational processes such as inventory management. Second, pure digital artificial intelligence systems are used in the search and booking phase of the customer journey, while robots are mainly used in the experience phase. Third, three main archetypes of artificial intelligence systems dominate the industry. Those archetypes are chatbots, travel assistants, and service robots. Fourth, the dominance of partnerships models between an employing company and a technology provider for the implementation of artificial intelligence systems.

Table 1: Collected use cases, area of usage [row] and kind of introduction [column]

	Partnership	In-House	Product	Others[1]	Total
Customer centric	21	15	6	9	51
Operations	7	1	3	2	13
Others[1]	3	-	2	1	6
Total	31	16	11	12	70

1) Others includes non classified cases, usage as a marketing tool and product production
2) Definitions: Partnership if system is developed, installed, and maintained by user and provider together; In-House if system is developed, installed, and maintained by user; Product if system is developed by developer alone

Table 2: Collected use cases, system archetype [row] and position within the customer journey [column]

	Searching & being inspired	Discovering, planning & booking[1]	Refining & improving	Experiencing	Reflecting & sharing	Total
Chat bot	5	8	2	3	-	18
Service robot	-	-	-	13	-	14
Travel assistant	-	9	-	-	-	9
Recommender system	2	2	-	2	-	6
Prediction system	-	2	-	4	-	6
Personalization[2]	-	-	2	2	-	4
Others[3]	-	2	-	12	-	13
Total	7	23	4	36	0	70

1) Stage 2 and 3 of the customer journey were combined, since there was no possibility to clearly allocate use cases belonging to either of those two stages
2) Personalization which are not recommender systems, e.g. mail personalization
3) Others include unclassified cases, customer intelligence platforms, translation services, smart speakers, and disruption management

What are potential reasons for the existence of those patterns? The selection bias could be one reason for those patterns. In the case of desk research and the collection of expert opinions a proper randomization is difficult to ensure or to test for. However, the selection bias aside the following

explanations come to mind: The dominance of customer centric applications could be based on a recent trend, identified during the expert discussion. This trend is the focus on customer experience. Intermediaries as well as inventory providers start to focus on their quality of offerings and services. Thus, they invest comparable less in operational excellence. The second pattern, namely the concentration of digital systems at the search and booking phase and robots at the experience phase of the customer journey is almost self-explanatory. Searching, planning, and booking via the internet is nowadays the norm (Preveden and Tiefengraber 2016). Thus, there are no hybrid systems necessary. However, during the experience phase, in which the traveler leaves the realms of the digital world, physical interaction, which can only be delivered by robots, regains importance. The third pattern is probably correlated to the first pattern, since chat bots, travel assistants as well as service robots are all representatives of systems used at the customer interface. However, the fourth pattern, namely that partnerships are often used to install AI systems, cannot be explained by the overarching trend of a rebound on customer experience. However, during the expert discussions it was revealed that most of the tourism industry does not consider technology a core competency and often lack the capabilities to self-develop and install such systems. It is probably due to this circumstance that companies prefer partnership models.

Impact of artificial intelligence on the travel and tourism industry

Artificial intelligence's generic impact on a certain task

If one looks at the collected use cases two basic generic impact dimensions of artificial intelligent systems appear. First, the automatization of tasks. Chatbots or service robots are typical representatives in which artificial intelligence is used to automate a task previously done by humans. This can be called the automatization effect. Nevertheless, automatization through artificial intelligence systems should not be equated with other forms of technology utilization which are called automatization, too. Nowadays, the automatization through self-serving terminals, whether

at airports through self-check terminals or at hotels through self-check in systems, is quite common in the travel and tourism sector (Ivanov and Webster 2017; Preveden and Tiefengraber 2016). However, the process itself is not automated but rather shifted from the organization to the customer. Artificial Intelligence on the other side truly automates these processes, so that neither a human at the organization nor the customer must do it. A recent example are AI supermarkets such as the 'Amazon Go' store in which an artificial intelligence system, which can recognize persons and objects, tracks people and the objects which they put in their shopping bag and automatically bills their purchases on the customers bank account (Stark 2017). A similar system is imaginable at hotels and airports in which a face-recognition system recognizes the arrival of guests and automatically checks them in. JetBlue is already testing such a system a Boston airport (Entis 2017).

The second impact dimension is the ability to improve decisions and enable previously not executable tasks. An example is the usage of recommender systems which offer personalized services and products, an offering not feasible without artificial intelligence. This can be called the improvement and enabling effect.

However, regarding the continuum concept of artificial intelligence, one should not look on these dimensions as fully separated entities but more than a path of development from automatization to improvement, respectively enabling. The example of a self-driving car brings some light to this concept. While self-driving cars obviously automate the task of driving the car, previously done by humans, they meanwhile also improve it. It is expected that at a 90% penetration rate of self-driving cars almost 90% of car accidents could be avoided (Fagnant and Kockelman 2015). In this case the artificial intelligence system started as an automation technology and developed into an improvement technology. A similar development is considerable possible for all kinds of artificial intelligent systems which are currently mainly used for automatization.

Artificial intelligence's direct impact on organizations

Striving away from the very generic impact of artificial intelligence systems, the question remains how travel and tourism organizations can use such systems. As any other mean of an organization artificial intelligence systems can be employed to increase its competitive advantage. That an employment of artificial intelligent systems leads to a competitive advantage was shown by a McKinsey Study in 2017. Early AI adopters with a proactive AI strategy reported around 2.5 percent points higher profit margins than the travel and tourism industry's average (Talwar and Koury 2017). According to Porter, such a competitive advantage can either be achieved through differentiation, meaning delivering superior benefits to the consumer, or lower costs (Porter 1989).

Differentiation through artificial intelligence systems

As described above artificial intelligence can impact a certain task either through the automatization or improvement and enabling effect. It is obvious how artificial intelligent systems which improve or enable a certain task such as recommender systems in the booking stage generate further benefits for consumers. The algorithms of such recommender systems predict which kind of product a certain individual customer desires. Obviously, this is an additional benefit and thus helps an organization to differentiate. The automatization effect, however, is often related to cost reduction. Thus, one could assume that artificial intelligence systems which automate tasks are mainly implemented to reduce costs. However, the collected use cases and the discussions in the expert group suggest otherwise. In the collected use cases the artificial intelligence systems which automate a task are often used to generate further benefits instead of simply reduce costs. For example, chatbots can undoubtedly be used to replace sales and service stuff at the customer interface. However, many companies use chatbots to expand their sales and service offerings instead, without reducing the respective staff. AirFrance-KLM uses its chatbots to sell its products and inform its customers about flight schedules via new channels such as the Facebook messenger. This service is available 24 hours a day and seven days a week. This is mainly because chatbots are

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pure digital systems and can thus practically scaled-up indefinitely (Kelly 2016). The consumer does not only get the opportunity to buy a travel product via a modern sales channel but is also offered all around the clock service and does not need to wait in a phone line to reach a free agent.

Cost savings through artificial intelligence systems

Artificial intelligence systems can generate cost savings through automatization if the usage of the artificial intelligence system, including installation and operation costs, is less costly than the usage of human labor (Ivanov and Webster 2017). The application of robots in the hospitality industry is an obvious example. In 2015 a Hotel opened in japan which utilizes robots to a large degree (Rajesh 2017). Although one can argue that the robots in this hotel are more used as a marketing tool to attract guests than as a true mean to save costs, it nevertheless shows the feasibility of such a model. A simpler use case would be the utilization of a vacuum cleaning robot to automate the task of cleaning the floor. It would replace a share of the existing cleaning personal and thus save costs. However, also artificial intelligence systems which improve an existing task or just enable one, can and are used for cost savings. For instance, the British Airline Easyjet uses artificial intelligence systems to better predict the demand of food and beverages on its flights. It reduces the inventory costs for the airline and helps it to sustain a cost advantage (emarketer 2017).

The degree of direct impact of artificial intelligence

A bottom up assessment of the direct impact of a certain artificial intelligence system on the travel and tourism industry is difficult to achieve, since an abundance of factors would have to be considered. However, to get at least an estimation a short poll within the group of experts was conducted. It determined the direct impact, cost savings and differentiation combined, of artificial intelligence systems, which were considered of special interest, on travel organizations in general. Furthermore, the poll included also the degree of effort for the organizations management and IT departments to install such an artificial intelligence system. The results can be seen in figure 6
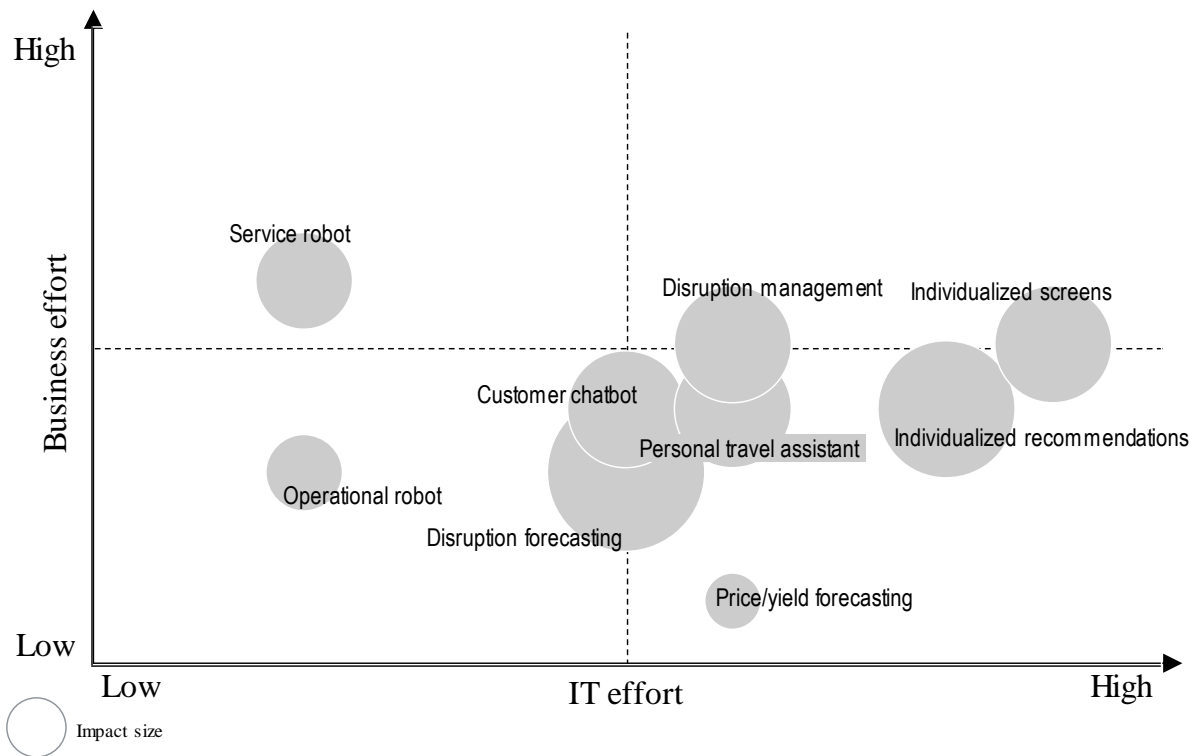
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Figure 6: Effort and direct impact of selected AI systems, own illustration

Artificial intelligence's indirect impact on organizations

Besides its direct impact on operational processes and offerings artificial intelligence also impacts indirectly through its utilization in other fields and by other organizations. For example, a food supplier for a hotel could use artificial intelligence systems to support its sales team in negotiations. This would probably increase the food and beverage costs for the hotel although the hotel itself did not change anything. However, the most notable indirect impact on travel and tourism organizations will be due to the adoption and perception of AI by the tourist. Especially the current marketing, sales, and supply system will be shaken up by AI systems. During the expert discussions it became obvious that artificial personal assistants, a AI system which assists its owner like a human personal assistant would do, will be an enormous opportunity and threat for incumbent travel companies. A lot of companies, technology blue chips as well as start-ups, are developing such systems. Two very well-known examples are Apple's Siri and Amazon's Alexa. The experts agreed that these personal assistants will become the new gatekeepers to the world wide web, replacing search engines or platforms such as Google and Facebook, as depicted in figure7. However, while the old gatekeepers

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were mostly unintelligent interfaces which were steered by the consumer, personal assistants make decisions by themselves, e.g. recommending a certain travel destination or transportation provider. Thus, questions yet unanswered like: 'How do I get the attention of such a personal assistant?' or 'How does it get paid?', are of great importance for the travel industry. Their answers will determine who will be able to sell its products to the tourist.
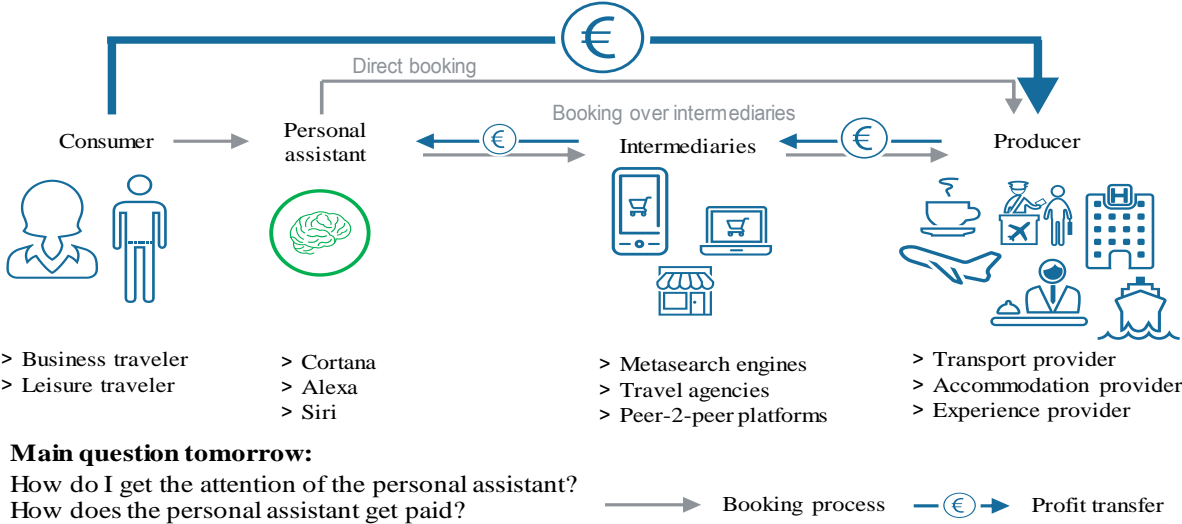

Figure 7: The sales and supply system in the tourism industry tomorrow, own illustration

A glimpse into the future

Up to here the thesis mainly dealt with the current status of artificial intelligence in the travel and tourism industry. Though, the industry must also look forward. The developments of four main issues were identified as of main importance. First, advancements in AI and underlining technologies; second, adoption rate and perception; third, reactions by the legislator, and fourth, development of talent.

Advancement in artificial intelligence and underlining technologies

As it was showed in figure 5 that artificial intelligent systems nowadays belong either to the group of narrow super-intelligence or narrow minor-intelligence. However, with the ongoing advancements in data gathering and storage as well as computational power artificial intelligence systems will get faster and more capable. Furthermore, it is expected that further advancements in

the AI algorithms itself will push their capabilities further upwards (Bostrom 2014; Tegmark 2017). Someday chatbots maybe chat better than any human could do, or robots offer better service than any human concierge. More and more systems will develop into the area of narrow superintelligence and thus their utility will grow as well. This is the current technological trend, depicted in figure 8. However, the scientific community agrees that the development from narrow minor-intelligence to narrow super-intelligence is only a small development compared with the development from narrow-superintelligence to general-superintelligence. This development is characterized by a so-called singularity (Bostrom 2014; Makridakis 2017). Originating from this singularity, artificial intelligence systems will steadily develop to reach any goal and execute any task better than any human could do. There is a lot written about the opportunities and dangers of this brave new world (Bostrom 2014; Tegmark 2017; Harari 2016). However, this is mostly science-fiction and the most research experts expect the start of this development not before 2040 (Bostrom 2014). Thus, in the coming years organizations should focus on the current development from narrow minor-intelligence to narrow super-intelligence.
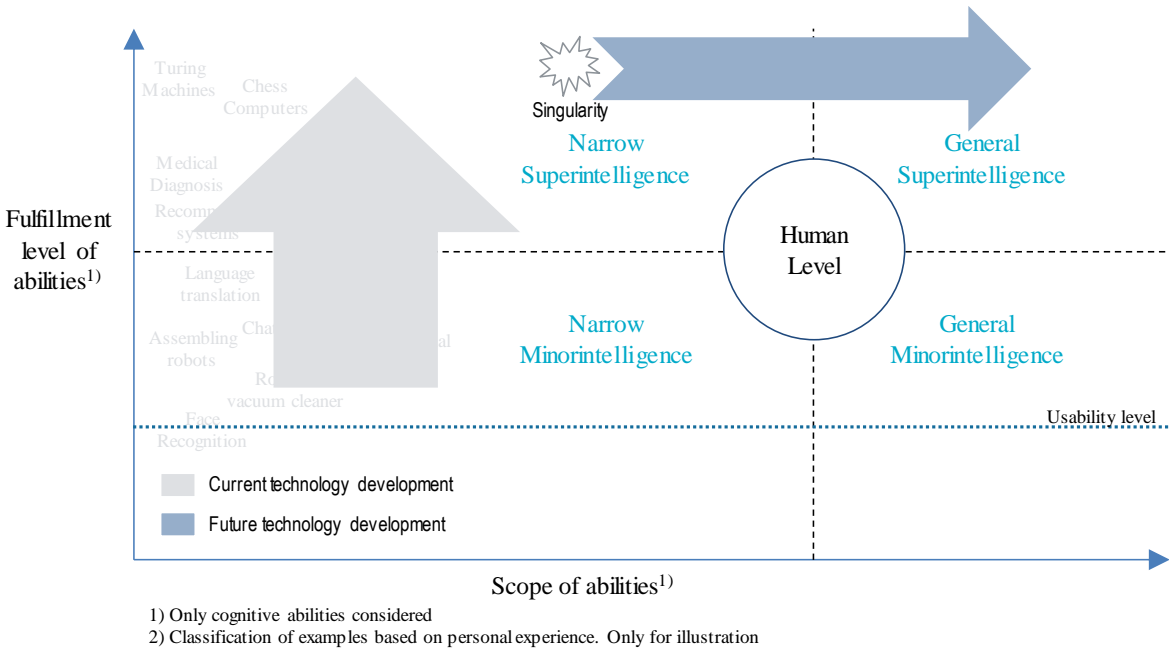

1) Only cognitive abilities considered
2) Classification of examples based on personal experience. Only for illustration

Figure 8: Development paths of the abilities of AI systems, own illustration

Developments in the perception and adoption of artificial intelligence

The travel and tourism industry must be aware that the decision about the usage of artificial intelligence systems does not solely lie in their hands. The industry must adapt to the customer's preferences. On the one side customers probably simply demand AI systems. This includes the so called 'AI everywhere' prediction in which almost every object is fitted with sensors and processing power to be a little bit intelligent (Condliffe 2017). For hospitality this could mean that customers expect that every room is fitted with a smart speaker, on which a personal assistant is running, or that the room's bed recognizes an individual customer and adapts its characteristics automatically. Certain customers, however, will likely act the opposite way and refuse artificial intelligence systems. Either because of privacy concerns about systems which use personal data such as recommender tools or because of sociological issues. For examples, as described by Murphy, Gretzel, and Hofacker (2017) this sociological issues, meaning to believe something is 'unnatural', will be a common adoption hurdle for service robots in the travel and tourism industry.

Though, the management of organizations must not only be aware of the customers perception of AI but also about the perception of AI by its own employees. The workforce need to be properly trained to work with artificial intelligence systems and must also be convinced that the employment of AI systems is in their own interest.

Regulation of artificial intelligence systems

In Europe, where a very rigid data protection regime is installed, the sharing and collection of private data is more challenging than in other parts of the world. However, during the expert discussions it was revealed that regulation is currently not a big issue – for systems which use private data – or no issue at all – for systems which do not use any private data, e.g. robots. However, this does not imply that this won't change in the coming years. Private data protection aside, the regulation of artificial intelligence is a very recent topic with renowned advocates such as Elon Musk (Etzioni 2017). The regulation of AI mainly deals with the question of which decisions

artificial intelligence should be allowed to do and how to ensure that the decision finding process obey the law. For example, the EU department of citizens' rights and constitutional affairs just issued a study about a European wide legal and ethical framework for robots (Nevejans 2017). Usually these studies are one of the first steps of incoming legislation. Thus, the travel and tourism industry must be aware that the current non-regulation of artificial intelligent systems will not prevail forever.

Talent development

All experts agreed that it will be crucial for travel and tourism companies to stay competitive on the workforce market. Regarding AI talents, the travel and tourism industry directly competes with all other industries. Nowadays, the technological blue chips companies such as Alphabet or Facebook pay AI developers six-figure USD starting salaries. Universities already complain that researchers are leaving their posts to earn bigger paychecks in the Silicon Valley (Metz 2017). Travel and tourism companies must monitor very closely how this talent shortage is developing in the coming years and adjust their offerings to employees accordingly. Otherwise they will lack the abilities to successfully install and run AI systems.

Conclusion

Coming back to the initially research question: 'How is artificial intelligence currently and in the future impacting the travel industry and what should I do as a travel enterprise about it?'

Today a wide potpourri of applications of artificial intelligence systems can be found in the travel and tourism industry, from recommender over price and disruption forecasting systems to service robots. Many of these systems are developed and installed in partnerships with technology providers. Artificial intelligence is currently impacting the industry directly, by enabling better offerings and lower operational costs. This will also prevail in the future. However, in the coming years the travel and tourism organizations will also see indirect impact from growing adoption of

AI systems outside their industry. For instance, through changes in the marketing and sales systems, since customers simply demand or reject artificial intelligence systems, and due to upcoming regulations. What should I do as a company about it? Within the expert group four main questions, seen in figure 9, were identified. Each travel company should ask these questions in the coming months to decide whether, how, and where to implement and use artificial intelligence systems.

In order to come up with a concrete utilization plan, travel organizations should start by answering the following questions

To what extend do we understand the technology?
- Do we have a clear understanding of what the new technology is, how it works and what it is capable of?
- Who can we partner with to ensure a better understanding of the new technology?

What will be the impact of the new technology on our ecosystem?
- Will the new technology disrupt our industry or sector?
- What will our competitors do and who are potential new entrants?

Where can the new technology support to deliver our proposition?
- How can the new technology improve our business model today?
- Which changes could be triggered by the new technology in the future?

How do we develop an implementation roadmap?
- How much technological competence do we have in-house?
- To what extend do we want to depend on a technology provider?
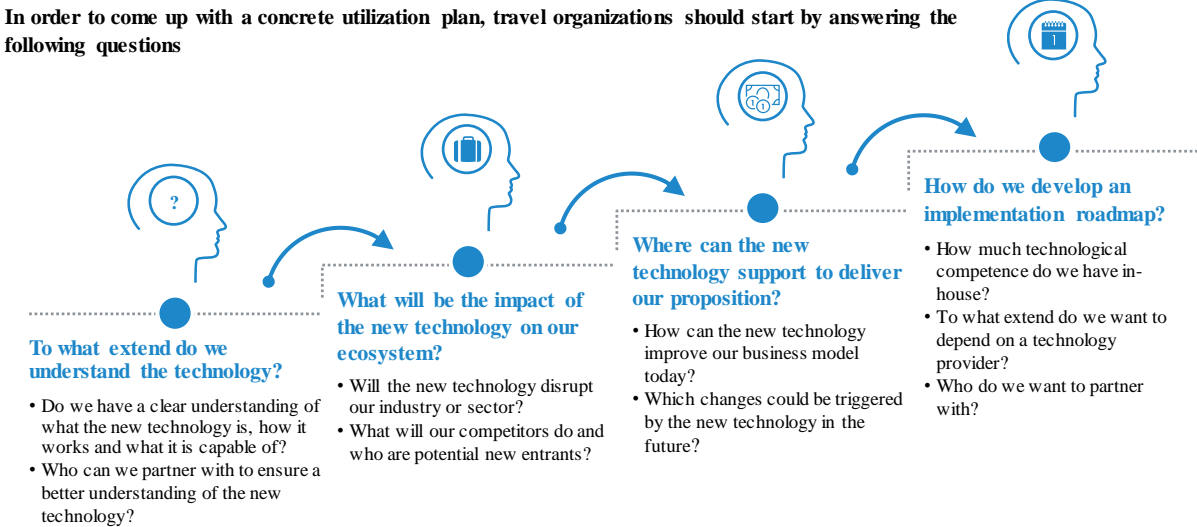- Who do we want to partner with?

Figure 9: Main questions for travel companies regarding AI technology, own illustration

However, the most important lesson for businesses to be drawn and on which all experts agreed is that they should continue to form partnerships. These partnerships include technology providers but are not limited to them. They extend to academic institutions, the regulators, and even competitors. In a world, where technologically, everything is possible, focus on the core business and looking for partnerships becomes more important. One player alone won't be able to collect all the relevant data, process it and make every decision. Either because regulation prevents it, data is distributed between several independent databases or simply because the talent and manpower is missing. Thus, organizations should enter partnerships to use AI systems in the most efficient way. But why not self-developing the AI systems? Start-ups aside, technology is not the core product for most of the travel and tourism industry. Their offering is to sell and enable travel experiences. Technology is only a mean to improve this offering and deliver it more efficient.

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