

The impact of robotics on the tourism sector: the case of Barcelona

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Abstract

This research analyzes the influence of robotics on tourism. It is an innovative phenomenon, but one that is expected to be present in most tourism and communication activities. Robotics is beginning to produce results in terms of jobs related to tourism. Robots are incorporated in all types of establishments, especially in hotels, restaurants and museums. The phenomenon is analyzed through a quantitative (implementing data from automatic check-in and check-out machines in Barcelona hotels) and qualitative (in-depth interviews) methodology. The improvements and drawbacks that they can represent are observed, as well as their repercussion on the tourism work environment. It is concluded that the inclusion of robotics in tourism is still in the development phase, but it implies personnel savings and more personalized and interactive attention for the end user. The machines are used more often in hostels and tourist apartments than in hotels.

Key words

robotics, innovation, interactivity, Internet, work, tourism, communication.

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The article studies the presence of automatic check-in and check-out machines in the HORECA sector

1. Introduction

The trend towards automation and the inclusion of technology solutions is fostering changes in different sectors, including service sectors, such as tourism. Robotics is beginning to be introduced in this sector, which we will analyze through the case of Barcelona.

The aim of this research is to analyze the impact of robotics on tourism and to observe the advantages and drawbacks that this phenomenon may promote or mitigate.

Structurally speaking, robotics is presented with regard to innovation and tourism, studying the specific case of Barcelona from a quantitative (the implementation of automatic *check-in* and *check-out* machines in hostels, hotels and apartments in Barcelona) and qualitative (through in-depth interviews with sector specialists) perspective. Finally, reflections are offered on the interest in these innovations in the tourism sector. Likewise, perspectives are presented for future research on this area of study.

2. Theoretical framework

There is a close relationship between tourism and technology, although it has accelerated in recent years as a result of the emergence of the Broad Band and Internet Society (Fondevila Gascón, 2010 and 2013a). Innovation is relevant to development in general and to tourism in particular, since it is considered an essential ingredient for competitive economic development in a dynamic, borderless environment like today (Herrera González & Gutiérrez, 2011; Caro, Luque & Zayas, 2015).

In the case of tourism, tourists can get information and reserve trips from their own home with a computer or any other terminal they want, such as a smartphone (Fondevila Gascón, Carreras Alcalde, Seebach & Pesqueira Zamora, 2015; Fondevila Gascón, Berbel, Muñoz González, Mir Bernal & Puiggròs Román, 2015; Fondevila Gascón, Berbel, Muñoz González, Mir Bernal, Puiggròs Román, Sierra Sánchez, Tena León, Santana López, Rom Rodríguez & Ordeix Rigo, 2016).

The tourism market generates an enormous offering, which stimulates innovation. For a product to take hold and capture the attention of a future customer, it must be different and innovative. This means that it will not depend on economic flows or temporary popularity, since it will have obtained a solid market, thanks to its own characteristics. The purpose of a product is to create a need, and thanks to innovation, unique, irreplaceable needs can be created (Valls, 2013).

When it comes to introducing an innovation, tourism is different from industrial products. It requires specific solutions that are used to increase the value of the products, expand their market or simply reduce costs. The tourism industry has a number of unique features (Weiermair, 2004). It produces and sells packages of products as opposed to individual, tangible products themselves. The lack of a need for warehousing, i.e., the simultaneousness of production and consumption, active customer participation, large capital assets that are involved in tourism marketing (such as intermediary companies, airlines, hotel chains or car rental companies) and the large number of staff members who interact in the different stages of production, intermediation, distribution and consumption are some clear differences.

On the other hand, we can classify the types of innovation based on those set out in the Oslo Manual. The definition of innovation in this manual is based on two criteria: changes that

Robots in the tourism sector attract the curiosity of people and stimulate communication

introduce significant modifications and innovations for the company or sector. A change can constitute an innovation for one company, but not for another. Innovations are organized according to this taxonomy: product or service, organizational, marketing, process, institutional and market (OCDE & EUROSTAT, 2006).

2.1. Product or service innovation

The innovation of a product or service consists of introducing new or significantly improved products or services in the market. This can include variations in the technical specifications, components, materials, software, user interface or other functional characteristics (Pino, 2012).

Thus, innovations represent the introduction of a new product or service in the tourism market, i.e., elements never before seen or novelties at a destination or in a company. The reaction of customers is what determines whether this new tourism element will be successful or not.

Significant changes in the characteristics of goods or services or the use for which they are intended in a tourism market are other unique features. Minor changes, changes in routine procedures and regular seasonal changes are not considered to be product innovations. Likewise, the reselling of products purchased from other companies does not constitute an innovation. On the other hand, what are considered product innovations are new services that represent improvements and amenities for customers, such as Internet services and the replacement of material elements with others that have better characteristics or simply with others that represent a reduction in energy costs (OCDE & EUROSTAT, 2006).

Navarro (2010) stresses that the product must provide value for both the customer and the company itself. For the results to be positive, product development must be well-planned and structured, permitting the control of future threats. It will thus enable the company developing it to increase sales, reach the market before its competitors, create products with better quality and value, keep costs down and position itself favorably in the market.

On the other hand, if a new product is not developed effectively, it will pose a serious threat to the company, since it can mean the end of its existence, due to the resulting repercussions. It is therefore very important to have a good structuring, systematization, formalization and communication throughout the organization to ensure the success of any organization seeking to be innovative. In tourism, innovations can refer to the design of dishes in a restaurant or the furnishings and decorative elements in any tourism service that create a different visual impact. The goal is to capture the attention and interest of the customer (Campo & Yagüe, 2011). Co-development has emerged as a method to create new products or services. In this phenomenon, two independent organizations join or collaborate with each other to develop a new product (Munuera Alemán & González-Adalid, 2007).

2.2. Organizational and process innovations

Organizational innovation is the application of a new organizational method in business management, the organization of job positions or external relations (Pino, 2012). An organizational innovation means new organizational methods, either internal or external, in a tourism company; this means changes in habits or routines, the workplace or external relations (ITH, 2007).

The most common changes in habits or business practices are the creation of a new database, using the most important current data from the company (Fondevila Gascón, 2013b), the integration of new monitored systems, a quality management system or the introduction of

It is observed that robotic applications are still in the developmental phase in tourism lodging establishments

employee training programs. The virtual transformation of travel agencies is one example of this change.

The new ways of organizing the workplace can mean a decentralization of the company's priorities and employee responsibilities, as well as the creation of specialized work teams or the integration of a program based on identifying the company's problems in order to determine their causes, which results in the creation of a new department and a new way of acting throughout the organization.

Innovations in external relations are based on reviewing and changing the rules for the control of suppliers and subcontractors, the search for investors and innovation collaborating on research and with universities (Camisón & Puig, 2014).

Research has shown the important role of technological innovation in the tourism sector. A positive effect of the concept of technological innovation is observed as applied to business performance. It is a decisive factor for adapting to new technologies. When analyzing whether the variation in results is associated with the use and adoption of technology (in the sense of both information technology and human resources) in rural tourism establishments in Galicia, no relationship was detected between the use of ICTs and the results of the company. However, a connection was observed between the business results and the characteristics of the human resources in a company. The combination of the impact of the use of technology and human resources does not minimize the results of the company (Sinde Cantorna, Diéguez Castrillón & Gueimonde Canto, 2009).

In the case of tourism, process innovations are based on introducing new production or service provision methods. In particular, all this implies changes in techniques, equipment and computer programs. These may thus be changes of both a tangible and intangible (technical) nature.

Nowadays, the new technologies are taking top position as the element of innovation that must be included in a tourism company. For example, ski lodges are including more and more elements of technology (ski lifts) and airports use increasingly more innovative methods for transferring luggage, goods and information, as well as for security purposes (Fundación EOI, 2015).

The introduction of platforms that improve service processes entails new automatic check-in methods that save time and money for both business owners and customers. In addition, more and more research and innovation are being directed towards the use of robotics in the tourism market. One experimental study on the main factors with a repercussion on product, process and marketing innovations in tourism companies in Pucón (Chile) showed the negative weight of websites on product innovation. On the other hand, process innovation has a positive influence, thanks to entrepreneurs who make risky decisions in their companies, Internet connections and the use of information and communications technologies (ICTs). Likewise, the use of ICTs and the participation in training courses boost innovation in marketing (Torres & De la Fuente, 2011).

2.3. Robotics and tourism: a recent relationship

In 1979, the Robotics Institute of America defined a robot as a reprogrammable and multi-functional manipulator that is designed to transfer specific materials, parts, tools or devices through a series of programmed movements in order to perform a variety of tasks (Raol & Gopal, 2013). Robotics is defined as a field of science and technology that deals with

The application of robotics is used more as a system to reduce costs than as an element of innovation

mechanical problems related to the analysis, design, control, measurement, application and maintenance of robots (Morecki & Knapczyk, 1999).

Geographically, robotics is concentrated in Europe, North America and Asia (Tobe, 2018). According to the International Federation of Robotics, in 2014 the sales of robots increased by 29%, in particular, impelled by the automotive sector and the electrical and electronics industry. Asia (including Australia and New Zealand) led the market with 139,300 industrial robots sold in 2014, 41% more than in 2013. Five markets represent 70% of the total volume of sales in 2014: China, Japan, the United States, the Republic of Korea and Germany.

Europe accounts for 32% of the market worldwide. Industrial robotics occupies a third of the market, while in the professional service robot market, European manufacturers produce 63% of the non-military robots. The European position in the service robots market represents a market share of 14% (SPARC Robotics, 2018). The SPARC initiative will contribute €2.8 billion to the sector. This public-private association between the European Commission, industry and academia is intended to facilitate growth of and strengthen the industry and provide value to robots, as well as promote research through production.

A robot is an autonomous system that exists in a physical environment, which can sense it and take action to achieve certain objectives (Mataric, 2007). Robotics studies robots, their autonomy and their purpose of detection and action in the physical world. The ISO standard, defined by the International Federation of Robotics (IFR), distinguishes between two types of robotics: industrial and service.

The definition of industrial robotics is found in ISO 8373; it states: “An automatically controlled, reprogrammable, multipurpose manipulator programmable on three or more axes, which may be either fixed in place or mobile for use in industrial automation applications” (AER-ATP, 2015). In 1960, George Devol gave the first demonstration of a device that combined the articulated mechanism of a remotely-operated system with the movement of each axis, based on the numeric control of a machine tool. This robot was capable of performing simple tasks through the programming method known as learning and was ideal for performing tasks involving positioning and transport. The first commercial industrial robot, developed by Engelberger, was marketed by Unimate in 1962. The first applications in the U.S. industry were initiated in 1967; in Japan, in 1968 and in Europe, in 1970 (Somolinos, 2002). Social robotics, artificial intelligence and smart services, virtual reality, 3D printing, the Internet of things and mobile and wearable technologies all form part of the Broadband Society. The profiles with the greatest risk of being replaced by robots are administrative, office and production positions, and nearly 50% of jobs are subject to being automated.

On the other hand, the ISO TC 184/SC2 Committee defines Service Robotics as “any type of robot that is not industrial.” The IFR also defines service robots as any “robot that operates partially or completely autonomously in the service of the well-being of humans and equipment, excluding manufacturing operations” (AER-ATP, 2015).

The history of robotics is linked to the construction of artifacts, which attempted to materialize the human desire to create beings in their likeness and that would free them from work. There are innovations in sectors that have led the evolution of robotics. One of them is the automotive sector (Rey, 2007). In fact, the mass production of automobiles in the early 20th century gave way to manufacturing and modular assembly, following the canons of vehicle flexibility. The automotive industry is characterized by its efforts towards innovation, which have led to the development of new models and features. One of the most frequently analyzed

Robotics in tourism is a simple adaptation of traditional and industrial robotics

indicators to optimize innovation in automobiles is that of electricity (Martín Hernández & Pérez Belló, 2004).

Innovation and the inclusion of robotics are not always associated with the capex (*capital expenditures*) sectors. On occasion, they have been used in more recreational environments, such as in the case of chess (Fernández & Pallarés, 2009).

Automation is found in all types of sectors. One of them is the health industry, with a strong technological impact that provides very noticeable benefits (Ayza, 2010). Another susceptible sector is the food industry, which directly impacts the tourism activity (Roca, 2006).

Automation has an impact on the tertiary sector, focused on customer service and subject to incorporating technology to improve service, as in highway systems, movie rentals or car washes (Diz Comesaña & Urgal González, 2012).

In tourism, robotization is beginning with what are apparently the simplest tasks, in spite of the fact that quality in the sector stems above all from the human factor as a factor of competitiveness and quality (Brotons Martínez, 2012).

The term robot, which means worker or paid slave in Czech, was adapted to refer to humans who perform repetitive, meaningless work, while science fiction described automatic intelligent machines. In the 1960s, engineers started to apply the term robot to re-programmable industrial machines that could perform a variety of independent repetitive tasks typical of an operator. In any case, robots were intended to replace humans in laborious tasks (Capek, 1996; Nocks, 2007).

The tourism work environment is suitable for the introduction of robots, in terms of accessibility and providing a unique experience for each tourist, with guided tours using GPS devices and *geocaching*. Museums can be accessible, such as the Australia National Museum in Canberra, which offers telepresence for those who cannot visit in person, and also speaks multiple languages. The idea of using robots for virtual tours can be extended beyond museums, using them for the virtual promotion of tourism destinations (Tourism Embassy, 2014). Translation services improve the experience of tourists and can add extra income for local tourism. Robots can even help with multimedia resources. In any case, the main impact is on the work availability generated by robotization, with options 24x7.

In terms of the specific sales of robots destined for tourism (professional services robots) and companion, assistant and humanoid robots, around 8,100 were sold in 2018. Japanese (especially Honda, Kawada and Toyota) and American, Korean and European companies are developing tourism assistant robots that go beyond mere toys and entertainment (IFR Statistical Department, 2015).

Service robots have recently appeared with applications in the tourism sector, such as room service in hotels and waiters. According to Travelzoo (2016), 80% of tourists expect robots (in an active sense) to be important in their lives in 2020, and 75% believe that their life will improve. Almost two-thirds of those surveyed feel comfortable with the robots that are used in the travel industry. The Germans and French surveyed were the most reluctant to adopt robots, while Chinese and Brazilians were the most positive about how they could improve vacations or travel in general. The main advantages of robotics are related to efficiency in general, data retention and memory. More than three quarters of those surveyed think that robots would be better than humans in data management (81%) and speaking languages (79%), while 76% think that robots have a better memory.

Research shows that robotics in this sector allows repetitive, dangerous and low-creativity jobs to be replaced

3. Methodology

The methodology used in this exploratory research, given the innovative characteristics of the study subject, is both quantitative and qualitative, and thus we opted for triangulation.

Thus, from a quantitative perspective, data are obtained on the implementation of automatic check-in and check-out machines in Barcelona establishments ($n = 105$), with 35 hostels, 35 hotels and 35 apartments. The availability of these data is limited, due to a lack of a representative sample of hotels with some type of robotized application. For this reason, we have opted to conduct a small study on the presence of automated machines in the receptions of different tourism lodging establishments in Barcelona. They are not robots in the strictest sense of the word, but they are a type of innovation that resembles them, albeit in a simpler form. In a reception area, both an automatic check-in and check-out machine and a robot are intended to innovate and facilitate the work for humans.

Qualitatively, three in-depth interviews are carried out, based on which the phenomenon of introducing robots in the tourism environment is analyzed, observing the improvements and disadvantages they can represent, as well as the repercussion in the tourism work environment.

An in-depth interview is a technique based on a designed and organized dialog in which both the interviewer and interviewee take part. The topics of conversation during the interview have been previously decided and organized by the interviewer. On the other hand, the interviewee provides information during the conversation about experiences, beliefs and desires with regard to the proposed topics. Therefore, an in-depth interview implies a conversation with purposes aimed at the research objectives.

In social research, there are three types of interviews: structured, semi-structured or focused and unstructured (Fondevila Gascón & Del Olmo Arriaga, 2013). To conduct this research, we have used three structured interviews with specialists in robotics Mercè Gamell (research analyst at the Nelmia Robotics company), Víctor Martín (general manager and founding partner of Macco Robotics and one of the creators of Macco, the Barman robot) and Francesc Cortés (industrial engineer with experience in several companies in the field of industrial automation). Topics addressed included the type of use of robots and the improvements that they contribute or can contribute to the tourism sector, trends and advice for the future, co-existence between the work force and machines and possible drawbacks.

4. Results

4.1. Quantitative results

The analysis considered the presence of automatic check-in and check-out machines in hotels, hostels and apartments in Barcelona. They were asked for information during the first quarter of 2018 on the reception hours and the use of automatic check-in and check-out machines.

During the information search process, it was observed that the best-known hotel chains and luxury hotels were precisely the ones that did not make use of this technology. It is inferred that automatic machines are used by the company to save on economic resources and personnel.

In some hotels, robots are used as support to streamline customer service and prevent gridlock when groups are checking in or at times of intense occupancy. Some establishments with few rooms or low occupancy rates use the machines because it would not be feasible to hire a receptionist.

The study indicates that the hotels that use these machines belong to more modest categories

In the Can Parera hotel, for example, the only way to enter is through an automatic machine, since there is no receptionist at all, even though it is a family hotel with only a few rooms. In the case of the Travelodge hotel in the Poblenou district, the machine makes it possible to streamline customer service and prevent lines when groups are checking in or at times of high occupancy, since this is a large-capacity hotel (250 rooms).

In the case of the Erik Vokel apartments, the machines perform the same function as a receptionist: they identify the reservation or show the available rooms with their prices, collect passport or national ID card information, photograph the guest for greater security, charge the amount for the stay and deliver the key to the guest. The function of the machines can include more services and options, depending on the accommodations. Robots act independently, securely and effectively. In the case of any incident, the establishments make a 24-hour hotline available to the customers.

The data on the establishments that use automatic registration machines reflect the trajectory of the sector (Table 1). Even though its consideration of robots is generous, they reflect a trend towards consideration, led by apartments (71.42%), followed by hostels (65.71%) and hotels (40%).

Table 1

Use of robots or automatic registration machines

Type of establishment	Percent of inclusion of robots or automatic check-in machines
Hostels	65.71%
Hotels	40%
Apartments	71.42%

Source: author's own work.

In terms of the presence of receptionists, there are many hostels (the Ding Dong chain, for example) that offer customer service from 7:30 am to 3:30 pm and from 11:00 pm to 7:00 am at the main office, using the machines as an element of support. In the case of the Río de Castro hostel, there is no reception service.

In terms of hotels, the use of automatic machines is not generalized (they are present in less than half), particularly in higher-end hotels. Those most likely to have this service are not located in the center of Barcelona and are one- or two-star (low-end) establishments. For example, the Travelodge Barcelona Poblenou hotel offers both an automatic and a staff-operated registration service 24 hours a day. It is a very large hotel (250 rooms), so the machine is used as a means of support to help prevent long lines. In the case of the Can Parera hotel, there is no reception service and lodging is only permitted with prior (on-line) reservation.

This type of machine proves to be very useful for apartments in Barcelona, both for companies that offer a large number of apartments (such as Erik Vokel Gran Via suites, for example) and for those that only offer a few (such as APBCN Eixample Center). Apartment staff confirm that the automatic check-in and check-out machines are very well accepted by customers.

Robotization facilitates the work of staff members, since in the case of having apartments spread out around the city, they can assist customers without having to travel and without

One of the conclusions is that the expansion of automated machines and robots in the sector is slow

having to hire a large staff. The machines are used in most apartments as the only method of registration, although they all have a concierge/reception center in one of their buildings in the event of any incidents. In the case of the Erik Vokel apartments, the machines are only used when there is no employee present at the reception desk, i.e., from 6:00 pm to 9:00 am.

In the case of hostels, it is observed that they use this tool as a replacement for an employee during hours with low demand, or directly as the only method of accessing the hostel. The hostels that use this machine do not have a large capacity for guests (12-18 rooms).

4.2. Qualitative results

The in-depth interviews carried out with Mercè Gamell, Víctor Martín and Francesc Cortés shed light on the subject of study analyzed in this research. The combination of perspectives from service and industrial robotics and industrial automation provides value when identifying opportunities and developing innovative strategies with the use of new service robotics. In the case of the waiter robot, the intent was to provide the same agility and quality as a person.

The position of the Spanish robotics sector on the global stage is adequate, particularly in the automotive industry. But in terms of service robotics, it does not hold a leadership position, as it has not been fully developed. Cortés states that “Spain is on the same level as any other European country, and even has some leading companies in this field.”

There have been several improvements in robots for business use. Gamell considers that, for decades, industrial robots have been an essential element for improving the productivity and competitiveness of companies, thanks to price reductions. In the environment of industry 4.0, smart companies are using machines, robots and people (through wearable and other devices) connected via the cloud to improve the efficiency of processes. For Martín, social robotics will be used in the hotel sector, since it will provide many advantages, “such as savings in terms of operating costs related to repetitive tasks.” Robotics in tourism will help create new customers, gain customer loyalty and, along the lines of the present research, manage check-ins and check-outs more quickly and efficiently. The productivity and competitiveness of tourism companies will experience a boost, since “robotics has always been involved with replacing repetitive, dangerous and low-creativity tasks.”

With regard to a possible Neo-Luddism, the three interviewees believe that robotics does not mean a loss of job positions, but rather the replacement of tasks. Accordingly, Gamell maintains that any task that can be predictable or mechanical will end up being replaced by a robot; on the other hand, those tasks in which the human factor is essential, that have high levels of creativity or where common sense is required, will be very difficult to replace. Martín states that “people who before were dedicated to tedious tasks have the opportunity to become more customer-oriented; in short, job positions are being transformed.” Cortés argues that whenever a technological change has occurred, some workers end up being replaced or dismissed. If in the short-term dismissals are to be expected, “over the long term there will be no loss of workplaces; there will be changes in occupation and a renewal of tasks.”

The main drawback that a robot represents in the workplace is in terms of safety, although they are all either adapted or protected by cells around them. Traditional robots had never before shared work space with humans. Currently, thanks to collaborative robots and their mobility, they can work together, detecting and avoiding obstacles. Another drawback is the economic facet: the company must ensure that it is a safe robot, and thus it must invest in modifications in the environment to facilitate the work of the robot, invest in new technologies and adapt the workplace.

The trend is that tasks that involve repetition and low levels of creativity will end up being replaced by robots

As advice for those tourism professionals who will irremediably lose their job, it is suggested that the threat must be approached as by any other professional, with confidence, flexibility and the skills needed to face any eventuality and be capable of shaping the future. The key is to be relevant in your functions and to learn constantly. Focusing on creative professions with high levels of technical knowledge will make it possible to avoid the danger of repetitive activities with little value. Providing much more personalized service and dealings with customers will make the difference. The large volume of future job positions will be generated by new business models that have not even been imagined yet, associated with broad areas that are suitable for robotic automation, such as the health, home automation and social automation sectors. Jobs like telephone operators, assistants, secretaries and nurses can be transformed, since a robot can place patients on gurneys or help them climb stairs. It would also be possible to automate judges, thus avoiding prevarications and possible direct or indirect bribes and corruption. In this sense, the figure of the Scientific-Academic Court of Justice has more credibility, using big data and objective data to avoid human prevarication. The jobs that are less susceptible to being replaced by robots are those of teachers, content creators, doctors (in some cases), engineers, architects and other jobs that require human thought and reasoning.

Tourism companies that want to apply robotics to tourism must consider activities that manage a large amount of data, which require physical strength, multilingual capabilities and time savings. As a negative aspect, it is necessary to anticipate the repercussion on employees, who must adapt and renew themselves. In addition, the impersonal relationship involved in working with a robot must be considered, which requires a period of adaptation by humans.

Even though robots have a negative connotation in western culture, in opposition to humans, in eastern cultures (Korea, China and Japan) they have naturally been adopted. The media impact generated by robots causes both acceptance and rejection. The concept of robotics is evolving, as awareness of the benefits that can be obtained increases, particularly in the areas of health and education. Emotional robotics generates greater acceptance. It is precisely a European project that is studying the acceptance of robotics, and in theory, no dysfunction is detected in its acceptance.

With regard to the profile of a person who accepts or rejects robotics, Gamell believes that acceptance is not derived from a personal profile, rather it depends on the task the robot is performing. The least accepted tasks are those that require “humanity,” such as caring for sick or elderly people, although it is pointed out that in these cases, robots can act as assistants. Both Martín and Cortés agree that young people are more likely to accept dealings with robots. Current generations are very used to working in digital environments and using technologies, so “it will seem totally natural to them to interact with a machine or robot.” However, the human touch will never be replaced or equaled.

5. Conclusions

The present research, based on the study of the robotizing presence of automatic check-in and check-out machines in hotels, hostels and apartments in Barcelona and the in-depth interviews that were conducted, allows us to observe that in tourist accommodations, robotics is still in a developmental phase and is used basically as a tool to save money (i.e., employee salaries), as opposed to a way to innovate and capture the attention of customers. These machines are more commonly used in hostels and tourist apartments than in hotels.

It is curious to note that the hotels using these machines belong to modest categories, and we only found two of them. With regard to tourism apartments, all of the businesses analyzed,

It should be stressed that higher-end establishments still opt primarily for human receptionists

except Erik Vokel, use automatic registration machines as a convenience for customers, preventing the need for them to travel to the central office. These companies manage several apartments in the city of Barcelona, and thanks to the automatic machines, they can check in and check out guests directly at the apartment. At Erik Vokel, on the other hand, they only use the machines during those hours when there are no receptionists, which are those with the least demand.

The expansion of automated machines and robots is slow, although they are occasionally used as the only method of registration and entry into some of the accommodations analyzed, which leads us to think that they can replace receptionists (with the detail that some degree of quality is lost in association with the human factor) and they can even be a marketing strategy. It must be considered that if higher-end establishments continue to opt primarily for human receptionists, it is likely that certain nuances of the job are not suitable to be performed by robots, thus affecting customer satisfaction. This is an aspect to analyze in future studies, since it would seem that robots can negatively affect the tourism experience and the generalization of robots would inhibit the spontaneity and authenticity of the tourism experience.

The in-depth interviews reveal that robotics in tourism is a simple adaptation of traditional and industrial robotics, and is a pioneering innovation. The robotics sector in Spain is dynamic. The benefits robots mean for tourism are focused on improved productivity and competitiveness of companies, the competitive advantage of which is innovation. Robotics makes it possible to replace repetitive, dangerous and low-creativity work.

The long-term objective of robotics applied to tourism is interaction with humans and the comprehension of their emotions, as well as the creation of safe robots without any type of risk. The trend is for tasks that involve repetition and little creativity to be performed by robots.

However, robotics will not mean a loss of job positions, rather a substitution of tasks. As occurred on other occasions throughout history and after three industrial revolutions and the arrival of the Broad Band Society, the adaptation process will involve new sources of occupation that require greater creativity and intelligence.

In terms of future lines of research in robotics, a Cambrian explosion is occurring as the result of the convergence of advances in different technologies, of which robots are an integrative element. More autonomous, mobile robots capable of communicating and understanding, which share learning via the cloud and with greater cognitive capacities are the subjects of more and more studies. As development costs become more affordable and it is simpler to access a robot, investments are being made in the development of processes that simulate artificial intelligence, making the interaction between robots and people more seamless and human. The sensitivity of robots enables them to work alongside people, and the growing trend is for robots to understand human emotions.

Regarding the future of robotics in tourism, social robots use cognitive technologies to communicate and relate to people in an increasingly natural way. Robots attract the curiosity of people and stimulate communication. For tourism this is the anchor point to provide new experiences for customers.

Another focus is data analysis: social robots will collect data by interacting with people. Robotics will provide greater efficiency for customers and businessmen and will make it possible to take advantage of Industry 4.0 (big data, broad band and artificial intelligence),

Increasingly more investments are being made in the development of processes that simulate artificial intelligence

multilingualism and time savings. Even though a long road lies ahead for robotics to attain the flexibility and intelligence of people, particularly in personalized customer service and interaction, in tourism, tasks that do not require creativity and repetitive tasks will be relegated to robots.

Furthermore, in the tourism sector, safety is an especially sensitive issue, due to the risk that robots could cause accidents. This drawback implies an investment in modifications to the surrounding environment, facilitating the work of the robot, investing in new technologies and adapting tourism establishments to a phenomenon whose progression should be monitored by scholars.

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