Chapter 3
The Deepening Effects of the Digital Revolution

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3.1 Introduction

Since the late twentieth century, the world has been engaged in a new scientific and technological revolution, which is rapidly affecting basic and applied research in disciplines as diverse as quantum physics, biomolecular chemistry, energy, materials, and most obviously, the new information and communication technologies (ICTs).

The effect of this revolution on society and on different fields of human activity is increasingly evident. In the case of travel and tourism the impact of ICTs and the Internet in general is particularly significant, bringing with them the new digital economy, new actors, their new "rules of the game", the new business models they require, and the increasing level of interaction with all of us. A digital economy based on a completely new infrastructure with new capabilities (telecom networks, hardware and software), a new way of doing e-business and the development of e-commerce (Mesenbourg 2001).

But before we embark on a deeper analysis of the new *digital age* in which we are now immersed, as an integral part of this new scientific and technological revolution and its impact on tourism, we must begin with a brief historical perspective, in order to see these changes in the context of *paradigm shifts* (Kuhn 1962), the evolution of the primary scientific paradigms that mark the history of humanity.

The concept of the paradigm shift has been a controversial subject since 1962, when the distinguished physicist and philosopher of science Thomas Kuhn published his famous book *The Structure of Scientific Revolutions* (Kuhn 1962). However, this chapter is not intended to contribute to that debate, but rather to use

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this concept as a theoretical tool, in order to find a mind frame for a given stage in the current scientific and technological context. Kuhn stated that "A paradigm is what members of a scientific community, and they alone, share, and conversely, a scientific community consists of men who share a paradigm" (Kuhn 1962, p. 176). What the members of such a scientific community share is not only a set of rational scientific theories; paradigms contain a certain understanding of the world, a series of accepted consensual values, ideologies and methods which go beyond the strictly scientific milieu and are shared by an entire society, its businesses and its governments.

3.2   From Newton to the New Technological Paradigm of the Digital Age

More than 300 years have passed since the celebrated English physicist, philosopher and mathematician Isaac Newton rewrote the basic principles that until then had enabled the scientific community to understand the known universe, by unifying in a single theory the natural laws which govern the movement of the Earth with those that govern the movement of the heavenly bodies.

His famous *Philosophiæ naturalis principia mathematica* better known as the *Principia* (Newton 1687), and the "law of universal gravitation", the crowning work of the Scientific Revolution, allowed Newton, starting from the theories previously developed by Kepler and Galileo in the early seventeenth century, to finally cast aside the dominant Aristotelian and Copernican paradigms and to introduce a new concept of the world, sparking off the first industrial revolution. Then, by the late eighteenth century, the industrial revolution was transforming most of the developed world economically, socially and technologically, and establishing the foundations of modern science and society.

Newton's new scientific paradigm would stand for over 200 years, until 1915, when the genius Albert Einstein published the *General Theory of Relativity*, still the basis for most of today's physics, which introduced the concept of the curvature of space time, and unified in a single equation the two basic sets of laws of Newtonian theory to produce the new relativistic conception of the modern world: the *Laws of Motion* and the *Law of Universal Gravitation*.

Immediately following Einstein's formulation of the theory of relativity in the early twentieth century, the last major branch of physics, quantum mechanics, was born. In 1925 Heisenberg introduced for the first time concepts such as the "uncertainty principle", which allows us explore the world at the atomic level with new rules, establishing a fundamental and still irreconcilable difference between the laws of the classical Newtonian paradigm and quantum physics. In a similar way, the Einsteinian space time relativity paradigm, which performance has been impressive at the macro scale, remains rather incompatible with the quantum physics paradigm, well tested and proven as well at the micro level.

In the context of the potential integration of the micro and macro physics paradigms mentioned above and while science still seems unable to find the so-called "The Ilustrated Theory of Everything. The Origin and Fate of the Universe" (Hawking 2003), two recent theories might assist in bringing us closer to a unified paradigm in Physics. One is M-theory, a variant on string theory based on 11-dimensional space, and the second is Loop Quantum Gravity, a simple model which would reconcile the fundamental macro-interactions of nature, the rules governing the largest phenomena with those ruling the sub-atomic quantum level.

But the micro and macro physics paradigms are not the only existing ones, focusing specifically on the technology arena, the period of change and profound transformation of the society in which we are living, spurred by social and geopolitical changes but also by scientific and technological advances is what the scientist Manuel Castells calls "the new technological paradigm" of the digital age (Castells 1998). This paradigm, articulated around information and communication technologies (ICTs) and the Internet, is transforming our "material culture" into an increasingly digital culture and digital world (Gere 2008).

In a broad sense, information and communication technologies (ICTs), form part of the myriad significant *technological breakthroughs* of the last two decades (such as advanced materials, new ways to produce, manage and distribute energy, new manufacturing techniques, nanotechnology, big data, cloud services, sharing economy, digital platforms, artificial intelligence, autonomous vehicles, blockchain and robotics). These new technologies are having an immediate impact on many of our industries and day-to-day activities, reshaping markets and sector around the world every day.

The new paradigm is characterised by a new shared *digital language* that allows us to generate, store, find, process, transmit and exchange information in increasingly massive and instantaneous ways. Its core is an authentic revolution in *information processing and communication technologies* that has an impact on how we all live: our society, our work, governments, companies, business models and, of course, the tourism industry (Castells 1996).

This new digital era follows the new rules of a technology whose raw material is information—a world of bits rather than atoms—characterised by:

- Immateriality and instantaneity;
- The capacity to reach every sector (cultural, economic, educational and industrial);
- Enormous flexibility and organisational fluidity;
- Organisation in the form of networks; and
- The capacity for these networks to combine and interconnect.

Because of these characteristics the technology can adapt to practically any environment and human activity, and its predicted growth and expansion can increase with new artificial intelligence capabilities, and with every new technological device that appears on the market, along with every newly developed material.

We are also on the threshold of a new revolution in materials, especially in the field of semimetals produced in laboratories applying the laws of quantum

mechanics. This coming revolution will lead to an exponential increase in the current capacity of ICTs, which is now reaching the limits of silicon semiconductors. The first quantum supercomputers, developed in recent years in the research centres of technological corporations and institutions such as NASA, Google and IBM, are achieving information processing speeds that were previously impossible, and as this technology is taken up it will enable us to face challenges that are now out of reach.

3.3 Major Digital Forces that are Changing the Tourism Industry

This digital age is driven, year on year, by a series of trends that create a feedback loop and demonstrate the rapid acceleration of the digitisation of society and the tourism industry. These include:

3.3.1 The Internet Continues to Grow

It may seem obvious, but the Internet is still growing strongly year on year. The Internet continues to grow as both a source of information and a marketplace for transactions with significant implications for the wider economy (by "Internet" we mean a world-wide computer network that can be accessed via a computer, mobile telephone, PDA, games machine, digital TV, etc.).

A few examples will give an idea of the speed of the change. According to the information given by *Internet Live Stats*, based on data from the *International Telecommunication Union (ITU),* it is currently estimated that around 46% of the world's population has access to the Internet, with a growth rate of over 80% since 2012, while in 1995 it was available to just 1%. From 1999 to 2013 the number of Internet users increased tenfold; user numbers reached one billion in 2005, two billion in 2010, and more than 3.4 billion by the end of 2016. Today more than a billion households worldwide have access to the Internet (Table 3.1).

Table 3.1 Worldwide internet users and internet penetration

Year	Internet users[a]	Penetration (% of world population)	World population
2016[b]	3,424,971,237	46.1%	7,432,663,275
2015[b]	3,185,996,155	43.4%	7,349,472,099
2014	2,956,385,569	40.7%	7,265,785,946
2013	2,728,428,107	38%	7,181,715,139
2012	2,494,736,248	35.1%	7,097,500,453

Source: Internet Live Stats 2017
[a]Internet user = individual who can access the Internet at home, via any device type and connection
[b]Estimate for July 1, 2016

Today's ICT development and Internet access is driven by the spread of mobile-broadband services. The growth of mobile broadband has largely outpaced that of fixed broadband, while mobile-broadband prices have dropped by 50% on average over the last 3 years, based on the report by the ITU (2017). These factors have resulted in about half of the world's population getting online and broadband services being available at much higher speeds, although the level of Internet penetration varies a lot depending on regions.

In terms of Internet content consumption, the most popular sites include YouTube, with over 8^9 videos viewed per day, Google, with over 3.8 billion searches a day, Facebook, with over 1.7^9 users, Twitter, which publishes more than 511 million tweets a day, Google+, with over 458 million users, and Pinterest, with over 137 million active users. Total web traffic represents more than 670 billion gigabytes a year. All these figures attest to the robustness of the Internet and the increasing use of applications, services, and websites of every kind.

It is unmistakable that the Internet plays a relevant and growing role in the worldwide travel sector. In Europe, online content is now a primary source of travel information, exceeding all other forms of traditional media and marketing, based on the report by the Tourism Economics, an Oxford Economics Company (2013). Online travel agencies and other travel businesses connect with potential travellers through everyday more sophisticated online marketing, social media, travel apps, online searchers, and booking platforms. These diverse information sources and sales channels increasingly drive and determine the evolution of tourism.

3.3.2 The Unstoppable Worldwide Growth of Mobile Networks and Smartphones

The presence of mobile phones is increasing steadily, according to ITU statistics for 2015. At present there are over 7 billion mobile phone accounts worldwide. Mobile broadband is the fastest-moving segment, with 47% penetration. Sixty nine per cent of the world's population is now covered by 3G mobile broadband networks. There are over a billion smartphones in use around the world, with an annual growth of 42%, according to the latest estimates by Morgan Stanley, especially thanks to emerging economies such as India and China which is now the world's largest smartphone market, with 350 million devices, ahead of the USA. Even though the level of penetration is still very low in the country (less than 30%), it gives us an idea of the remaining room for expansion.

The growth of smartphones brings with it the growth of mobile services, e-commerce and payments via mobile phone, and the use of mobile apps in general—a change which is transforming how we work, how we relate to others, and everything around us including travel.

Due to this last trend, the Internet traffic generated by mobile devices is rising fast. Current estimates show more than 20% of worldwide Internet traffic is
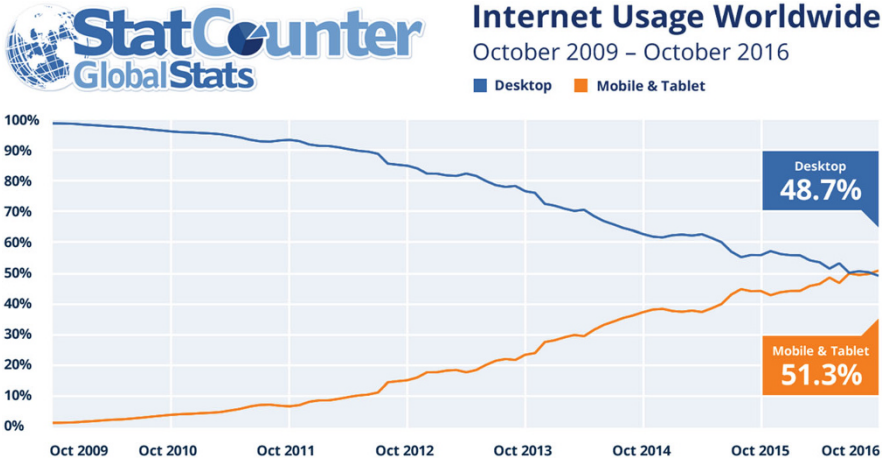
Fig. 3.1 Internet usage worldwide. Source: Statcounter 2017

generated by this type of device. StatCounter Global Stats finds that mobile and tablet devices in 2016 accounted for 51.3% of Internet usage worldwide in October compared to 48.7% by desktop, as it is shown in Fig. 3.1.

For the first time in 2017 businesses are set to spend more on mobile Internet advertising than for advertisements seen via desktop computers and, as the travel sector is one of the biggest players of online advertising, travel booking on mobile continues to grow as a popular channel for travellers all over the world. It could soon become the predominant way travel is booked online worldwide.

Travellers are booking more on mobile due to larger smartphone screens, easier mobile payment methods, and more confidence on their mobile devices. On the other side, the industry (airlines, hotels, and online travel agencies) has made both apps and mobile websites friendlier and easier to use. Another important trend is last-minute travel deals, which are also helping to drive mobile sales, as consumers opt to book right away via their smartphones, especially younger consumers, the so called "millennials" (Future Foundation 2016).

3.3.3 The Internet of Things Continues to Grow

There is no doubt that the Internet and mobile devices are playing a key role in the disruptions impacting tourism in the early twenty-first Century, but a potentially more dramatic change looms on the horizon: the *Internet of Things*, also known as IoT.

IoT refers to embedding Internet-ready sensors inside everyday physical objects like buildings, appliances and vehicles. IoT is already shaping up as a transformative force in different sectors and activities. Increasing numbers and types of objects can

now connect to Internet, and the volume of data they generate is growing. In the near future, there will be more objects online than people. Being connected to the Internet means these items can be identified, they can receive and send information, as well as receive instructions from other equipment, just like human users. In other words, these are objects with a certain level of intelligence, as is already happening with our televisions, fridges, thermostats and trainers.

This new world is much "smarter" (Smart TVs, Smart watches, Smart cities and destinations), and more interconnected. Everything is becoming connected to everything else, with the physical dimension coexisting with the digital and social dimensions, creating hybrid, multichannel worlds and experiences that are now practically inseparable.

Some forecasts consider that 8.4 billion connected things will be in use worldwide in 2017, up 31% from 2016, and will reach 20.4 billion by 2020 and the total spending on endpoints and services will reach almost $2 trillion in 2017 (Gartner 2017). Although it is true that we are still at the beginning of this trend to ubiquitous connectivity, the boom in smartphones, which we are using for more tasks every day, plus the growth in smart city and destination projects, increasingly connected infrastructure, practically omnipresent wireless connections, and ever more pervasive Internet access, will certainly be accelerating in the next few years.

As the real world becomes more digitised, the convergence between the physical and the virtual worlds becomes increasingly transparent for companies, users, destinations, and in general for anyone with this information. New companies and business models emerge based on new types of services leveraging the advantages of this new environment and the new rules of the game.

This growing tendency to digitise everything around us means that the new devices are becoming more important, with greater capacity to record higher quality pictures, video and sound, but also with the possibility of measuring and recording variables in- and outdoors (such as the temperature of a given location, light levels, water cleanliness, air pollution levels, the movement of people in the street or cars on the road) and transmitting them via sensors and other devices, which is represented in Fig. 3.2.

These sensors of the new IoT world can transmit information in real time thanks to the wireless technologies already mentioned (WiFi or wimax), as well as many others, such as Bluetooth, radio-frequency, NFC and infrared. A good example of a type of low-consumption transmitter is the iBeacon. Those devices can be configured in networks to gather information from the IoT into enormous databases in the cloud. The information collected in the cloud could be process thanks to Big Data enabling unimaginable things such as self-driving cars, unmanned aircraft, organising urban traffic and more efficient waste collection.

The opportunities created by IoT are still moving forward in many sectors, including tourism, and some airlines, airports, hotels and destinations have already implemented pilot initiatives to bring their customer's both online and offline experiences, and we will certainly see more of this in the years to come.

Fig. 3.2 The connected city. Source: Free stock photos 2017

### 3.3.4 Big Data, the World's Most Valuable Resource

Big Data applies to information that cannot be processed or analysed using traditional processes or software. It is understood as all the systems that let us handle large amounts of information, as they can capture, store, process, search, analyse and view huge volumes of data, will continue to be a major technological trend in coming years.

In fact, the growth of the Internet of Things is one of the elements driving the development of Big Data, insofar as increasing numbers of devices are going online, delivering information for processing and receiving instructions based on that information.

According to the 3Vs model (IBM) Big Data has three basic defining properties or dimensions: Volume, Variety and Velocity (in some recent models an additional V for Veracity has been included). Volume refers to the amount of data, the size of available data has been growing at an increasing rate, more and more sources with larger size of data. Variety refers to the number of types of data, from excel tables and structure databases to an enormous amount of formats (text, photo, video, web, sensor data and relational data bases). Velocity refers to the speed of data processing, initially, companies analyzed data using a batch process but now the data is streaming into the servers in real time. The 3Vs model is represented in Fig. 3.3.

The travel industry was one of the earliest adopters of Big Data, from Online travel agencies, to air traffic controllers to hotel managers, in the year to come there
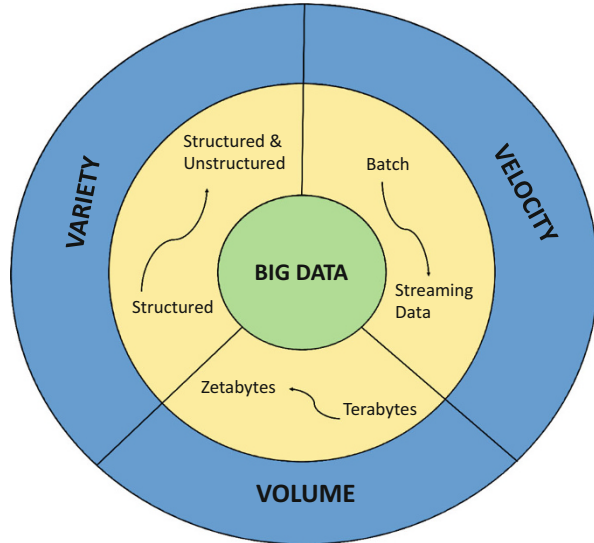
would not be a single actor of the travel industry whose job is not directly affected by
big data. Most of them have also had access traditionally to plenty of data for many
years. Every airline reservation, every hotel stay, every rental car and train reserva-
tion leaves a data trail. It all adds up to hundreds of terabytes or petabytes of
structured transaction data in conventional databases—big data by any standard of
measurement (Davenport 2013).

However, big data is not just about volume. It is also about the variety and
velocity of data. Increasingly travel arrangements are discussed online in ratings and
blog sites, liked and disliked on social networks, and complained about or praised in
call centre conversations. The data arrives at a pace much faster than traditional
structured data ever did. To understand a customer's travel experience, a company or
a smart destination has to add new forms of data to its repertoire (Davenport 2013).

The tourism sector is an intensive sector in the generation and use of digital
information that can be analysed using big data techniques. The competitive advan-
tage in travel industry more and more often is going to be driven by the ability to
anticipate, predict and proactively meet the needs of its customers; an ability that can
only be exercised through big data.

3.3.5 The New Cloud Services

Cloud computing has recently emerged as a new paradigm for hosting and delivering
services over the Internet (Zhang et al. 2010). The "Cloud", or remote online
services, continues to be a rising trend in every sector. The Cloud lets us store

information on Internet servers without using the storage space of our device, responding to our requests on the fly.

This new model for providing business services and technology enables a secure, flexible and scalable response to the needs of the moment. This has made concepts like "software as a service" and Web 2.0 possible.

It is currently estimated that there is one exabyte of data stored in the cloud (1 exabyte equals 10^{18} bytes). To give an idea of how much information this is, in 2007 the annual Internet traffic was estimated as 5–9 exabytes. At present, the size of the Internet is estimated as close to 500 exabytes. Meanwhile, it is estimated that 60% of the world's servers, over 50 million, have already been migrated to the cloud.

Confidence is also growing in our "personal clouds"—every day, more people share photos, videos, and files of every kind through the spreading of services like Dropbox, Google Drive, Microsoft OneDrive or the Apple cloud, available through smartphones, or even, in the case of OneDrive, via gaming consoles such as Xbox.

Cloud services and cloud computing in the travel industry can give travel agents access to better and more flexible technologies, hyper-scalable solutions, more security and much more mobility (allowing access, share and book from everywhere anytime).

3.3.6   The Smart Wearables

Smart wearables are becoming increasingly pervasive driven by the continuous miniaturisation of electronics; advances in sensor technology, computing power and connectivity; and an ever stronger capability to embed intelligence in electronic (and photonic) components and systems, ultimately coupled by a reduction in the price of components (European Commission 2016).

Wearable technology covers any technology that we can wear, as more and more devices become connected and technology becomes smaller manufactures are able to incorporate advanced capabilities into everyday items. In the last few years, especially since the presentation of Google Glass, and more recently the Apple Watch, "wearable" devices are increasing steadily. Although the market is still in the early stages of its life cycle, it has a potential for a huge development. A conceptual model for wearables is explained in Fig. 3.4.

Thanks to the embedded intelligence, connectivity and an ever-increasing usability, wearables offer unique opportunities for condition/activity monitoring, feedback and actuation/delivery services (e.g. drug delivery or stimulation), localisation, identification, personal contextual notifications, information display and virtual assistance. In simple terms, smart wearable devices and applications can monitor, document and augment our lives.

This term refers to garments and accessories that incorporate some sort of technological device. In 2016, 150 million wearable pieces were sold, more than 100 million of these alone were smartwatches, the rest were devices integrated into clothes and accessories such as bracelets.
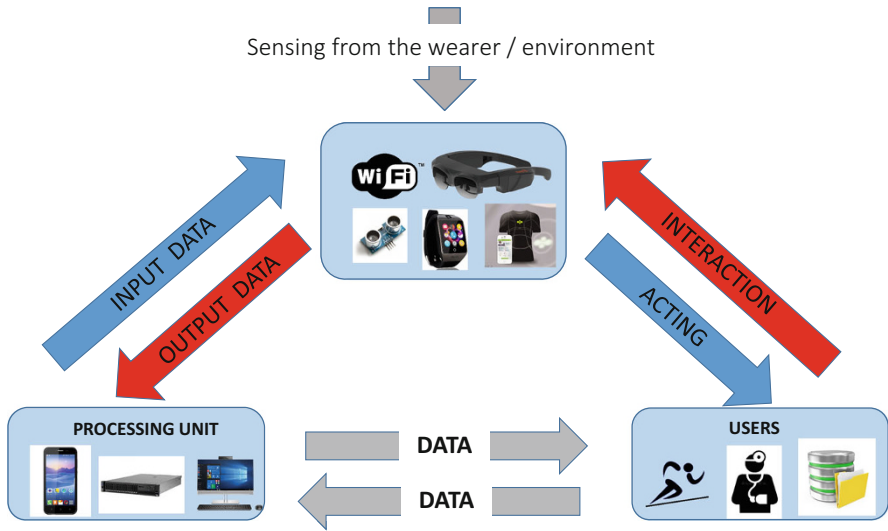
Fig. 3.4 Conceptual model for wearables. Source: European Commission (2016)

As the use of these devices spreads, the number of apps developed for them will also increase, as will the traffic generated by the data they share. The most fashionable devices include watches and bracelets that interact with smartphones, especially relating to health, but also outdoor exercise and routes for running and walking, with bracelets by companies such as Fitbits, Jawbone Ups, and Nike FuelBand.

All these technologies will require ever more sophisticated software based on language technology for recognising natural language, image processing, recognition of faces and places, and more precise interaction with natural language, making them easier to use. The travel industry is already incorporating some of this technology to improve customer experiences in hotel resorts, planes or cruises. Those devices could facilitate a number of things such as opening cabin doors for guests, facilitating transactions for drinks or food, check in and check out processes, improving safety and security and many other uses to improve experience personalisation.

3.3.7 Faster Connectivity and More Capacity

As wireless telecommunications networks such as WiFi, WiMax and Redes Mesh become more widespread, alongside the arrival of the 4G mobile technology, we have faster and better connections to networks with increasing capacities, giving us
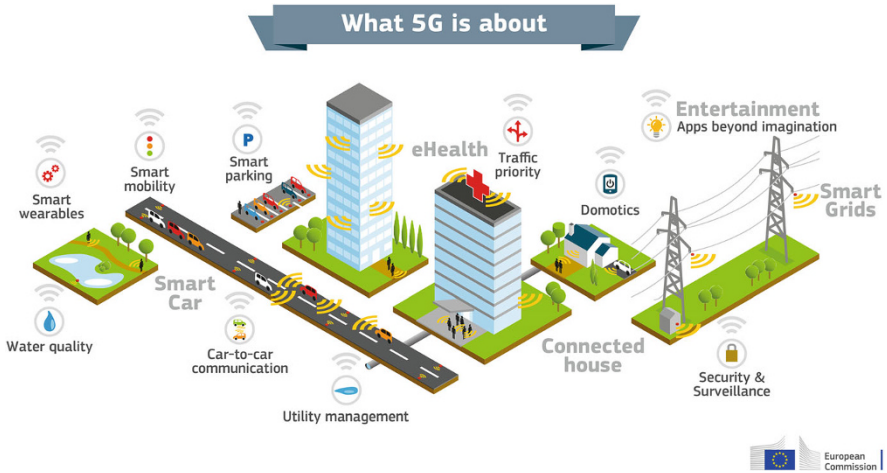
Fig. 3.5 What 5G is about. Source: European Commission (2015)

faster Internet access and data transmission on mobile devices than ever before. Greater penetration of smartphones in the leading markets is usually accompanied by an equivalent increase in the capacity of telecommunications networks.

But it is not just about more and faster smartphones it is also about the growing importance of IoT devices and sensors asking for quick connections from everywhere (home appliances, door locks, security cameras, cars, wearables, dog collars, and so many other inert devices). From the current 6.4^9 connected devices in the world to over 20 billion devices that will be connected to the Internet by 2020, according to Gartner predictions.

According to the European Commission The "fifth generation" of telecommunications systems, or 5G, will be the most critical building block of our "digital society" in the next decade. This new cellular technology will be a truly converged network environment where wired and wireless communications will use the same infrastructure, driving the future networked society. It will provide virtually ubiquitous, ultra-high bandwidth, "connectivity" not only to individual users but also to connected objects (European Commission 2015). A representation of the 5G Smart City is shown in Fig. 3.5.

In technical terms, 5G means higher data rates, minimal latency and low power consumption. In simpler terms, a movie is downloaded in seconds, driverless cars react faster than humans and the IoT realises its potential. Today, the technology giants are already gearing up for this hyper-connected future, with Amazon and Google's push into virtual assistants for smart homes, and Facebook forging ahead with live video. 5G will be key to this new digital paradigm.

In the case of tourism, being constantly connected increases the probability of the growth of real-time context-aware services, 5G will transform the communication channel of the whole travel industry. Meanwhile, a large part of the content consumed online is in the form of videos with better and better resolution, and we will be

able to access them with better conditions than before, driving consumption not only in the home, as was customary until now, but outside as well while travelling or waiting at the airport.

3.3.8 The Spreading of Social Networks

Social media has become a part of every industry across the world and travel is no exception. This trend is continuing with no sign of slowing down, with more users joining every year. In 2017 we reached 3^9 users logging onto social media platforms around the world, which means that almost half of the world's population spends at least part of their day updating their status or story (Fig. 3.6).

In the social medial digital landscape Facebook is leading with over 1870 million active users (18% market share), followed by the Facebook-owned, WhatsApp. Following from this, Asia Pacific Platforms, with QQ, one of China's oldest social networks, (9%), WeChat (8%) and Qzone, a Chinese social networking site and blogging platform, a Facebook-style Chinese social network (7%) all with over 600 million active users. Following them there is a cluster of predominantly western social media networks such as Tumblr (6%), Instagram (4%) and Twitter (4%).

There are increasing numbers of businesses present on social networks, and it is hoped that in the future it will be easier to integrate them and the information they generate within the business process when designing new products, building brand awareness, increasing customer loyalty, obtaining feedback, raising visitors' expectations or during the process of providing an added value service for clients, and taking advantage of the user generated content during the tourist cycle.
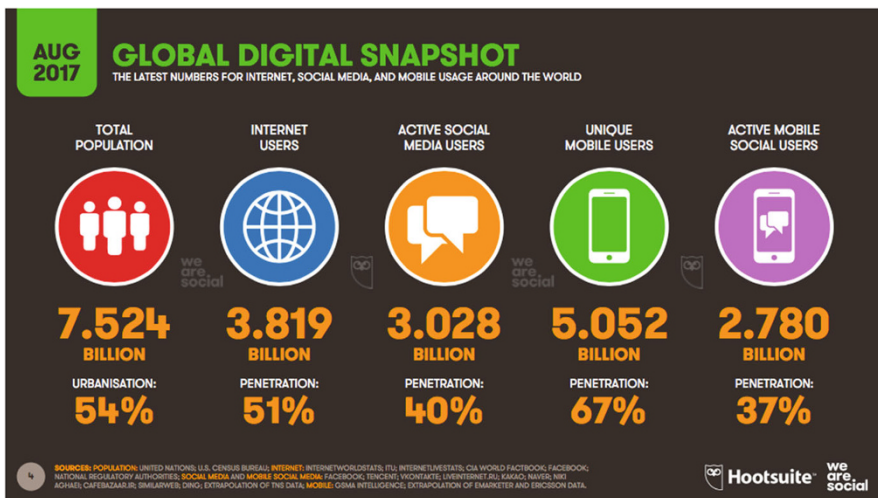

Fig. 3.6 The global digital snapshot. Source: Hootsuite (2017)

It is important to take into account also that the new social platforms scenario allow a permanent dialog between the travel service providers and its clients that was previously not available. On the other hand, as a traveller, you can share experiences and opinions during your trip, and ask questions to other travellers or to your service provider in a very easy and transparent way. It helps others to know what other people are doing and what attractions are the must-see destinations of a location.

This is the reason why nowadays social networks have become a seamless part of a traveler's experience—from researching their trip (best airlines, hotels, etc.), to engagement throughout the duration of their travel and even post-trip reviews and feedback. At the same time travellers are becoming increasingly influential thanks to social media monitoring and listening to what is said on the social networks provide to the travel industry with very relevant insights.

3.3.9 Artificial Intelligence

Artificial intelligence is a branch of computer science concerned with the attempt to develop complex computer programs that will be capable of performing difficult cognitive tasks (Eysenck 1990). The goal of the artificial intelligence is to build machines that perform tasks normally requiring human intelligence through the use of complex algorithms.

Artificial intelligence has a massive potential to change how we live, how we work and how we travel, but we are already using it sometime without notice it, it is in our smartphone, our car, our bank, and in our house, all use artificial intelligence on a daily basis. From voice-powered personal assistants like Siri, Google Now, and Cortana (depending on the platform: iOS, Android or Windows Mobile), to more fundamental technologies such as behavioural algorithms, suggestive searches and autonomously-powered self-driving vehicles boasting powerful predictive capabilities, there are several examples and applications of artificial intelligence in use today (Domingo 2015).

Artificial Intelligence allows companies to collect information on our requests and habits using that information to better serve us results that are tailored to our preferences. Any of the digital assistants we are used to talk with through our smartphones learn about ourselves every time we ask them something, and that it will eventually develop the ability to anticipate similar users' needs.

In the coming years Artificial Intelligence will also become smarter, faster, more fluid and human-like thanks to the inevitable rise of quantum computing:

> Quantum computing built on the principles of quantum mechanics, they exploit complex and fascinating laws of nature that are always there, but usually remain hidden from view. By harnessing such natural behavior, quantum computing can run new types of algorithms to process information more holistically. They may one day lead to revolutionary breakthroughs in materials and drug discovery, the optimization of complex manmade systems, and artificial intelligence (IBM 2017).

Quantum computers will not only help us to solve some of the life's most complex problems and mysteries regarding the environment, aging, disease, war, poverty, famine, climate change, the origins of the universe and deep-space exploration, it will soon power all of our Artificial Intelligence systems, acting as the brains of these super-human machines. It will be used for big, high-impact applications.

Good examples of Artificial Intelligence applied in the travel sector are IBM with its Watson project used in some destinations as a recommendation engine for tourism (Lanzarote, Spain) or the use Google Maps does of anonymized location data from smartphones, to anticipate the speed of movement of traffic at any given time. But it combines that information with user-reported traffic incidents like construction and accidents provide by the crowdsource traffic app also owned by Google called Waze. Access to vast amounts of data being fed to its proprietary algorithms means Maps can reduce commutes by suggesting the fastest routes to and from work.

In some cases Artificial Intelligence is used to determine the price of a room or of a flight ticket, or to minimize the wait time at the airport or to optimized certain process in the travel industry (Boztas 2017). Online travel agencies are starting to use it in recommendations to their clients for services you're interested in as "customers who viewed this item also viewed" and "customers who bought this item also bought", as well as via personalized recommendations on the home page, in the same way Amazon does.

It is important to note that you need huge volumes of data and queries to process in order to train an Artificial Intelligence system, so online travel agencies and big airlines have an important advantage, as they are the ones managing the greatest number of transactions in the travel industry in a completely new world of opportunities.

3.4   Effects of the Digital Revolution on the Travellers Cycle

Tourism is not immune to the technological trends presented above. Technology has always formed part of the value chain of the tourism industry, but it also plays this role for clients, who are rapidly taking up mobile technology, smartphones and mobile apps, thus accelerating the speed and intensity of the challenges facing the sector. Companies and tourists are using this technology more, interacting with each other to improve their bottom line on one hand, and get more out of their trip on the other.

If we consider travel as the subject of study and as impacted by the new technological trends, we can differentiate these trends according to how they affect the traveller before, during and after the journey, as we will see below.

3.4.1   The Impact of Technology on the Pre-Travel Stage of the Cycle

One of the first ways ICTs impacted the tourism industry appeared with the arrival of the Internet. The world wide web, and all the new online agents which appeared and continue to appear, radically transformed how we were inspired when choosing a destination, planning and organising the trip, looking for information, making reservations, finding our way around the destination, and expressing our opinions about it. A new online ecosystem was created for travel, which while it did not completely replace the previous ecosystem, changed it considerably and made it much more complex and sophisticated, which is represented in Fig. 3.7.

The Internet and the different devices used to access it created a completely new content and sales channel which permitted the emergence of new types of operators,

Fig. 3.7 The online travel ecosystem. Source: eDreams Report (2017) and Travel Report (2017)

infomediaries and intermediaries in the tourism industry, whose presence in the market has continued to grow ever since.

A good example of these new players are the OTAs (Online Travel Agencies)—the leaders at the global level are part of the Priceline group, including Booking.com, Priceline.com, Kayak.com and Agoda, and their main competition is the Expedia group, we could considered them the "owners of the online traffic", in Asia the competitor is C-trip.

It is important to note that vertical Metasearchers have become an essential turnpike for acquiring the online traveler's traffic, which has caused many of them to be acquired by big OTAs (Kayak by Priceline, Trivago by Expedia, Skyscanner by C- trip, Liligo by OdigeO). They are increasingly powerful and, together with Tripadvisor, Google Flight Search, Google Hotel Finder, Momondo and Rome2Rio, they are one of the main sources of traveller's acquisition, in which the volume is directly linked to the cost, and this benefits the big and already positioned players. Without any doubt this is one of the defining characteristics of the current online travel ecosystem.

In 2013, the number of travel reservations made online increased by 65%, while traditional agencies and tour operators grew by just 4%. This is a channel where new intermediaries and infomediaries (search engines and metasearches) are constantly emerging and competing with each other to attract the attention of potential tourists and increase the conversion rates per website visitors. It should be remembered that the average traveller visits more than 20 websites before deciding on a booking.

These intermediaries include new infomediaries and social networks for travellers, such as TripAdvisor, through its "*Profile Plus*" or Google with "*Hotel Finder*", which have also set out to serve the world of online hotel and airline sales and bookings, aware of the huge numbers of visits they receive and the enormous amounts of relevant content made available to them in the form of user opinions. There are also private shopping clubs, travel auction sites, and websites offering discounts on online sales of travel, activities, or restaurant services (Fig. 3.8).
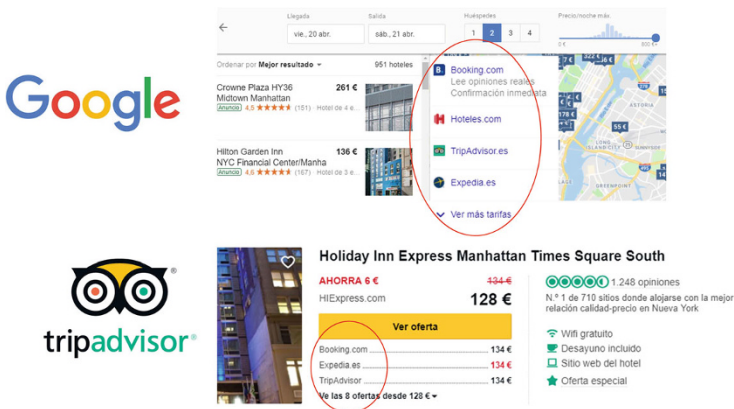

Fig. 3.8 Google and tripadvisor booking functionalities. Source: Blogger.com (2016)
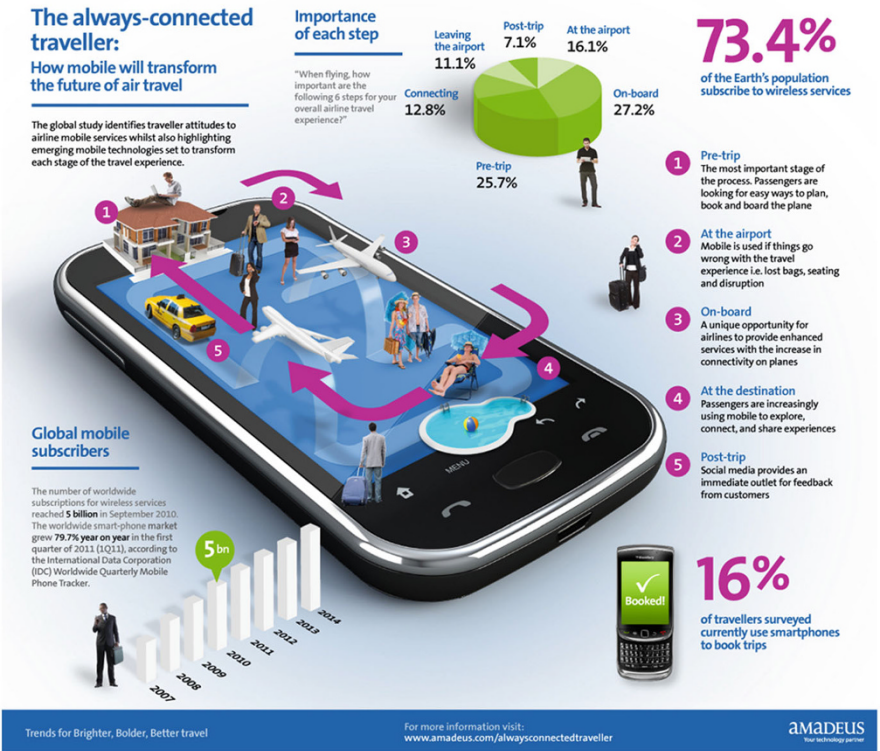
Fig. 3.9 The always-connected traveller. Source: Amadeus (2013)

Meanwhile, alongside the unstoppable consolidation of the Internet as the benchmark channel for travel bookings and sales, travellers are becoming increasingly dependent on their smartphones and apps, as an alternative way of using Internet resources rather than visiting traditional websites. These are the "always-connected travellers" described by Amadeus in their 2011 study which is represented in Fig. 3.9. This trend is increasingly important for tourism sector companies and for destinations, and we will devote part of this section specifically to the subject of mobile travel apps.

It is estimated that nowadays, three out of four travellers have a Smartphone, and they are using them more intensively than ever. Travel bookings via mobile phone continue to increase by double digits every year, especially in certain types of trip and accommodation categories (for example, last-minute bookings). A recent study by Carlson Wagonlit Travel (CWT) estimated that at the current growth rate in the use of mobile devices, by 2017, around 25% of all bookings will be via mobile. Also a recent study by Skift shows that smartphone bookings seem to be higher for one-night stays (Fig. 3.10).

Fig. 3.10 Booking by device depending on the duration of stay. Source: Skift (2015)

Another area where new technologies are producing significant changes has to do with how these technologies and the new environment of the Internet are reinventing online tourism marketing.

In this field, the trend is towards increasing multi-channel marketing (on any device, with clients encountering multi-device marketing at any time, with consistent content on all of them) and increasing audience segmentation—this is the era of "sniper marketing": any one of us could be a target, and it has the advantage of being totally measurable.

The idea is to make tourism services ever more personalised, based on the increasing amounts of information that companies can gather on the tastes, habits and characteristics of their clients in relation to the experiences they want from their travel. The better we know our client, the more we can micro-segment our marketing and promotional campaigns.

Finally, the fastest growing way of consuming Internet content is the increasingly intensive use of video, which is displacing other formats for getting information and exploring a destination at the inspiration stage. The capacity of the video format to convince and engage potential tourists to a destination is increasing all the time, as Google remarks in a recent report, showing that views of YouTube videos relating to the travel industry increased by 118% in 2014, and 30% of the visits were via mobile

phone, reinforcing the trend discussed above towards a more intensive use of smartphones (ThinkwithGoogle 2014).

In the next few years we will see how the current 4G telecommunications networks are superseded by 5G networks, which will have a much greater capacity than the current infrastructure, making it easier to consume high-resolution digital content in highly mobile contexts, accelerating the current consumption of information linked to tourism content.

3.4.2 The Impact of Technology while Travelling

To understand how the main technological trends are affecting the actual trip, it should be noted that technology is making the automation of processes much more efficient. A good example of the growing automation of some processes is the ability to check in and check out in airports and hotels with mobile devices, payments using technologies such as NFC (Near Field Communication, a short-range wireless communications technology for sharing data between devices), and opening doors with the same technology, or RFID (radio-frequency identification thanks to RFID tags), or other technologies which will soon arrive, such as biometric identification.

One field of application of ICTs that is going to have a great deal of influence on what we do at the destination related to monitoring behaviour at the destination, both in enclosed spaces like a hotel, a restaurant, a convention centre, a cruise ship, a shopping centre, an amusement park or an airport, and in open spaces such as a neighbourhood, a city, a nature reserve… In a nutshell, a destination, such as what is represented in Fig. 3.11.

Today we have the technology we need to gather and measure real-time information on all our movements and how we interact with the environment (what we consume, and when), in order to anticipate needs and facilitate interaction with other travellers or the tourism service providers. Gathering and analysing all this information lets us significantly increase our understanding of spaces and the experiences that can happen in them during our trips, in order to improve the experience.

The dominant trend is towards more mobile, more social, and more contextual technology. This obliges us to design strategies to position our brands and destinations based on what some call SOLOMO (Social & Local & Mobile), which is represented in Fig. 3.12.

Mobile technology means we can develop new services for tourists based on their geolocation. Locating the individual enables us to provide an important added value to applications, such as alerts, recommendations, finding people or things, invisibly designing tours, and managing tourist flows around the tourism resources of a destination. Also, this type of service can be complemented by and integrated with content created by the users of applications and social networks, "user generated content", making it possible to offer custom guidance and interaction with similar users during the trip.

Fig. 3.11 Heatmap of travellers' location, San Sebastián, Spain. Source: Hosteltur (2010)

Fig. 3.12 The SOLOMO concept model. Source: Tecnohotel (2012)

For the big digital players of the industry the new battle ground are the activities in destinations. In this new frontier of the digital travel ecosystem we could find experienced players like Viator or Getoyourguide, with new challengers like Zozi, and with giants like Google with its "Trips" product; Booking.com with its project with guides and proposals in destination; or Airbnb with experiences provided by the hosts. But we should not forget traditional players like Hotelbeds or GTA, which want to change the concept of bed banks into activity banks.

The key will be the ability to operate in a marketplace where, on the supply side, the service suppliers are organized and have to guarantee availability and price online in real time, and on the other, the services reach the travellers in the right stage of their trip, which in many cases will be in destination, through their mobile devices.

In terms of technology applied to intelligent transport, increasing numbers of cities are experimenting with personalised buses (such as the Kutsuplus in Finland, which responds to users' requests, recalculating its routes to cater to them and optimise its journey), or mobile apps that tell users when a bus will arrive at the stop (as in the application in use in Madrid), or mobile apps which help find parking spaces, such as the company Wesmartpark. This area also includes apps to help people share car rides.

Another important trend, especially for tourist destinations, relates to the "gamification" of travel and the travelling experience.

Finally, and from the point of view of Destination Management Organizations (DMOs) and smart destinations the digital transformation allows them to promote their destinations, products and services, as well as, at the same time, using technology to know their visitors profile and adapting to them as never before. It also allows them to offer more personalised, higher quality products and services (segmentation and hyper-segmentation of the market, reduction in costs, greater efficiency and competitiveness...). The new tourist needs must be met by the destination, which has the opportunity to use technological solutions to improve the visitor experience.

A visitor expects a destination to be smart, i.e. that it anticipates their needs and wishes. The visitor does not want to have to request a service. These smart destinations, as well as offering the traveller a host of advantages, enable tourist service providers to familiarise themselves with the likes of their potential consumers, the activities they engage in or the time they spend at a certain place. All of these data, which are increasingly easy to obtain, thanks to technology, must be taken advantage of in order to offer a better service to travellers and to manage better the destination (SEGITTUR 2015).

Moreover, during the trip at the destination technology plays a key role in making all points of exchange of information that tourists may have during their time at the destination more fluid and comfortable, and this is thanks to the new devices currently offered on the market: smartphone, computer, tablet, SmartWatch, augmented reality glasses or advanced robots.

Among the devices that may have a greater impact for smart destinations, the smartphone is, for now, the most important digital device in recent years—and seems set to remain so. There are more and more applications and functionalities that make users use mobile or tablet more—to the detriment of computers, and this is never more the case than at tourist destinations, where mobility is such an important element.

On the other hand, both the SmartWatch and augmented reality devices are becoming increasingly common among technology users. Only a few years ago, when a tourist was visiting a new place they were limited to merely admiring the sights, tasting the local dishes, enjoying traditional music and feeling the warmth and aroma of another culture. Now, the traveller has a new sense through those channels that let you live another kind of experience, thanks to technologies such as augmented reality, where all you have to do is take a photo of a monument and it instantly recognises and displays all the information that appears about it on the Internet.

These techniques are a good way to retain tourists and create loyalty, while helping to organise their journeys and enriching their interpretation with interactive activities, competitions and digital kiosks where they can share what they are doing on social networks during or after their trips.

3.4.3   The Impact of Technology on the After Travel Stage of the Cycle

The end of the journey is the start of a stage in which travellers talk about their experiences, share it with friends on social networks, or post about it on their own blog. Sometimes they also rate the services they received in the form of reviews and feedback. At this stage everything relating to social media becomes essential—we cannot ignore the fact that 85% of Internet users are on social networks.

The fact that tourists share their opinions online offers enormous potential for the tourism industry, as they can see what clients think of their brands and services compared to their competitors, and have a valuable opportunity to improve. New technological solutions have emerged to monitor the presence, image and reputation of tourism companies or destinations on social media. A good example of this type of solutions for the hotel sector is the company Reviewpro, which specialises in gathering and analysing opinions on the leading social networks: an example of semantic analysis from Reviewpro is represented in Fig. 3.13.

These new abilities to interpret and analyse large volumes of reviews quickly are part of what is known as "*sentiment analysis*", made possible by the enormous development of semantic technology, which can interpret natural language in real time in different formats and media.

The opinions most often analysed are on TripAdvisor, Booking.com and Twitter, but there are many more places where we share information online, and being able to

Fig. 3.13 Semantic analysis example. Source: Traveldailynews

analyse and join in real-time conversations and reviews of our services can become a major competitive advantage.

The most popular social network for leaving travel reviews and recommendations (hotels, restaurants and activities) in 2017 is still TripAdvisor, which operates in 200 countries, in 21 languages, and with more than 455 million unique visitors per month (most of them by mobile devices), over 570 million reviews and opinions on travel, more than 115 million photos uploaded by travellers, and reviews of over 7 million places to eat, sleep, or have fun, and 136,000 destinations.

To sum up, we can state that ICTs have revolutionised the tourism industry at every stage of travel. Today, much of the competitiveness and profitability of the tourism industry depends more and more on our capacity to use these technologies to interact with consumers, provide them with greater added value, personalise the services we provide for them, reduce costs, and in a nutshell, get a strategic competitive advantage over our competitors.

3.5   Conclusion

Over the next few years we will see how many of the technological trends that have been mentioned throughout the chapter develop and impact much more intensively along the entire value chain of the tourism sector. Among which we can highlight the following:

- The smart use of Big Data and artificial intelligence to improve the visitor experience and service customization: It is about being able to personalize the services to tourists based on their profile, their context, their buying habits and behaviour in general. Its generalized implementation will significantly modify the marketing processes, favouring the process of personalization of tourist products and increasing expectations and satisfaction.
- Immersive reality or mixed reality as the result of blending the physical world with the digital world: It is made possible by advancements in computer vision, graphical processing power, display technology, and input systems. This technology can be able to generate experiences for guests before or during their trips, as well as offering a preview of what they can enjoy in their destination, triggering an anticipated pleasure.
- Processing of natural language: In order to interpret the searches of tourists in the destination or tourist services. Commonly used in the main search engines of the Network, it is still little used among the actors of the tourist activity. Its potential is remarkable, in speed and response orientation, the new browser will be the voice.
- Processing of feelings and emotions of the visitor: Linked to Big Data and Internet of Things, but with its own path, not yet sufficiently implemented. Complementary natural language. Knowledge of the reactions of tourists to information inputs or experimentation is key in the knowledge of non-verbal

communication. The management of this information will be a major break-through, but it has ethical limitations.

- Virtual Reality (VR) and Augmented Reality (AR) technologies: are used primarily in video games, however, tourism is a sector that could benefit a lot from them, if potential travellers were readily able to experience new and exotic locations without leaving their houses. VR could be a very useful marketing and promotional tool, but also it could enrich immersive VR tours around a destination. AR could provide holograms or mobile apps that could add virtual elements to real-life situations while you are travelling.
- Customization and Artificial Intelligence (AI): the demand for personalized experiences is being consolidated, mainly among the segments of greater economic capacity considered within quality tourism. More and more tourists want to differentiate themselves from traditional mass tourism, enjoying experiences and destinations with a greater degree of authenticity and adapted to their needs. In order to respond to this demand, from the technological point of view it will be necessary to develop and apply different algorithms for profiling tourists and recommending experiences based on Artificial Intelligence.
- New interaction interfaces: although the main means of interaction with the most widespread technological devices (PCs, laptops, tablets and mobile devices) continues to be the keyboard and the screen, we have seen how the mobile in many regions of the world has already exceeded the Traditional PC. We will be talking about a transformation to a mobile environment, a multi-device tendency, with mCommerce and mMarketing features. At the same time as language technologies and conversational systems improve, the voice will increasingly be used as an interface for interacting with machines.

All these technologies, together with many others mentioned throughout the Chapter, will condition and determine the ability of tourism companies and destinations to compete in the battle for the new digital traveller.

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