Advanced technologies for smart tourism destinations

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Abstract

The use of smart tourism technologies has been pervasive and growing. here we briefly examine the most interesting and promising technological systems that may allow destinations to function in more efficient and effective ways for providing satisfactory experiences to their visitors. Practically all of these are based on a heavy use of data that today might be available in huge quantities because generated by the intensive use of online applications. Beside the technological aspects, however, we remark that good outcomes from the implementations can only be obtained when correctly considering the need for revising operational and organizational processes and make them suitable for a digital treatment.

Introduction

The wide diffusion and the evolution of digital technologies have profoundly changed all aspects of our lives and have had an incredible impact on countless economic sectors, tourism above all. The idea of attributing *intelligence* to the modern technologies has, recently, led to the emergence of the concept of *smartness*.

Although different disciplines provide different definitions for ‘smart’, in practice a smart environment can be loosely thought to be one in which a widespread use of Information and Communication Technologies (ICTs) allows all stakeholders to access easily knowledge and information thus facilitating and making more efficient their activities and providing value to their users or customers.

In the last few years, these concepts have been applied to tourism destinations and the term ‘smart tourism destination’ has been coined (Baggio & Del Chiappa, 2014; Boes et al., 2015; Buhalis &

Amaranggana, 2014; Gretzel et al., 2015). A growing number of studies have been attempting to analyze, also empirically, the technological and business foundations of this concept along with the technologies and the architectures that a tourism destination that exploit to be totally smart. Further, the most part of existing studies seems to suggest, at least implicitly, that the wide and pervasive use of technology alone might make it possible to consider the destination as being 'smart'.

This occurs despite the fact that when assessing the relationships among stakeholders within a destination the real (i.e. offline) and the virtual (i.e. technology mediated/driven) components need to be considered as being structurally strongly coupled and co-evolving, thus forming a single system (Baggio & Del Chiappa, 2014; Del Chiappa & Baggio, 2015). Hence, it is crucial to deal with the *smart* approach in destination management and marketing by paying good attention to everything needs to be planned and implemented (e.g. revision of processes and practices, changes in organizational culture etc.) to render this fascinating technology-driven business model real and effective.

The adoption of cutting-edge technologies and its combination with efficient organizational models may promote cooperation, knowledge sharing, and open innovation among service providers and offer innovative integrated services to visitors making the basis for considering *smart* a destination. The net result is an increase of attractiveness of a destination and the provision to tourists of higher levels of novel and unique experiences.

Modern automated methods allow better understanding visitors' desires and behaviors by exploiting the huge quantities of data made available by the intensive use of online environments and new technological models (augmented reality, robotics, internet of things, blockchain applications etc.) give destinations a series of effective tools for reaching their objectives.

In what follows we examine briefly the most advanced and promising technological developments and discuss possible application frameworks and the basic requirements of integration and standardization for effective and efficient use of these technologies.

Finally, we consider that, to be effective, a destination needs to measure and monitor constantly the basic parameters that concern its touristic offer and the response of actual and potential tourists through a well organized and planned dashboard in order to acquire all information needed for its strategic and operational activities.

Internet and the Web

The birth date of the Internet is commonly set to 1969, when the first four computers were connected. In the next years the network grew and stabilized its architecture adopting the TCP/IP (transmission control protocol/internet protocol) protocol suite. Internet came into broad public use with the emergence of the World Wide Web in the mid-1990s. and become a mass phenomenon at the beginning of the current century. In almost fifty years an incredible number of technologies were developed and widely diffused, so that today practically any form of communication using any form of message format (text, numbers, sound, images, video) uses this fundamental infrastructure.

The Internet is what is called a foundational technology, a basic 'invention' that do not provide a *disruptive* application per se but enable progress and applications in a variety of areas and create a

complex ecosystem able to modify radically the domains that are affected. Foundational technologies may take decades to penetrate and integrate with economic and social infrastructures, the process of adoption is gradual and steady. Their adoption depends on the novelty of the applications and the complexity of the coordination efforts needed to make them practicable. Low levels of novelty and complexity help a fast acceptance. Those with high novelty and complexity may take years or decades to evolve but then have a great transforming power for the social and economic environment (Iansiti & Lakhani, 2017).

Main aspects that favored this diffuse adoption of the Internet (and the Web) are the technical choices that underlie its structure (Carpenter, 1996; Schewick, 2010):

- *openness and standardization*: the system is an open system. Its use is based on standard protocols agreed and shared between the different actors. The standards are public and available freely to anyone who wants to use them;
- *protocol layering*: all functions are performed by different levels of software that communicate between them. Each level consists of multiple entities (applications, processes, hardware, etc..) and performs a specific set of operations;
- *modularity and interoperability*: objects, systems and programs are made up of small independent parts that can be aggregated to provide specific functions of greater complexity, the use of standard protocols and formats allows a smooth interoperability of hardware and software devices;
- *neutrality*: the network behaves neutrally with respect to the capabilities of the terminals connected (end-to-end) and to any kind of application.

In this virtual world we have seen the most creative and innovative accomplishments, some of which have profoundly changed our ways of living and working and completely transformed whole economic and industrial sectors. As a set of general-purpose technologies, the Internet creates value in itself and form a particularly prolific humus extremely effective for the production of applications that help people and companies perform their work or help them to do so more efficiently. This huge influence on the very essence of social and economic structures has produced perception that the difference between the 'real' and the 'virtual' worlds seems to disappear. As Wellman stated some years ago (2001: 2031), computer networks, more than technological systems have become *"inherently social networks, linking people, organizations, and knowledge"* and have evolved into "*social institutions that should not be studied in isolation but as integrated into everyday lives.*" And Luciano Floridi in his *Onlife Manifesto* states that (2015: 7): "*the ever-increasing pervasiveness of ICTs shakes established reference frameworks through the following transformations:*

i. the blurring of the distinction between reality and virtuality;
ii. the blurring of the distinctions between human, machine and nature;
iii. the reversal from information scarcity to information abundance; and
iv. *the shift from the primacy of entities to the primacy of interactions.*"

Data, data, data

One consequence of the global diffusion of ICTs, mainly in the form of Internet online applications, is that a vast number of digital records are created continuously and much of these data can be

collected, stored and studied. Moreover, the relatively recent addition of connected physical devices and sensors (devices that sense their environment), that can transmit their recordings, has further widened this possibility.

The term commonly used for this phenomenon is “Big Data”. Although the large quantity is the most visible feature, other characteristics are worthy of attention because they drive the issues and the opportunities associated with this development: the variety of the forms they assume (texts, videos, images etc.), and the dynamicity and variability, intrinsic features of most unstructured records that can assume different meanings in different contexts even if they have similar forms, and the variance in these meanings that can occur over time.

Traditional statistical methods for the analysis are often not sufficient or unable to provide meaningful outcomes. Moreover, the basic features of Big Data may need extensive use of hardware and software and new approaches such as those made available in the framework of artificial intelligence (AI) and machine learning (ML). These terms have almost become synonyms, but machine learning, as part of the wider field of AI is the faster growing field and has produced the most commonly used techniques for automatically treating data.

AI was originally defined by Minsky (1967) as a technology (or machine) that can perform a task that, if conducted by a human, would require *intelligence* to complete. Subsequent definitions ascribe AI with the capacity to learn, sense, reason and take action as well as to detect, deliberate and develop on its own to 'discover which elements or attributes in a bunch of data are the most predictive' (Buhalis et al., 2019; Minsky, 1967; Sterne, 2017)

Machine learning is (Samuel, 1959: 211): “*programming of a digital computer to behave in a way which, if done by human beings or animals, would be described as involving the process of learning*”. Thus, it implicates giving a software program the ability to modify its behavior according to events (input data) and outcomes, without being explicitly programmed to handle each specific situation. Applications range from data mining programs that discover general rules or patterns in large data sets, to information filtering systems that automatically identify users based on interests or preferences, to clustering large collection of objects into a small number of classes, to recognizing shapes or sounds, and so on.

Many applications today, and for what is foreseeable in the near future, provide useful and effective outcomes for the general practice of the analysis of tourists’ behaviors and desires, for general business intelligence and for the predictive capabilities of some algorithms, examples exist that make more effective several forecasting activities (Mariani et al., 2018). And these in tourism are among the most important efforts. Moreover areas such as recommendations systems or revenue management can exploit the vast amount of data that otherwise would have been hardly treatable with traditional methods (Oussous et al., 2018; Qiu et al., 2016).

Internet of Things and robotics

When well coupled with some mechanical device, modern artificial intelligence and machine learning software form robotic assemblies, that is machines capable of carrying out a complex series of actions automatically, that can be guided by some control device or, in some cases,

autonomously. Widely used in manufacturing plants and other settings, for dangerous or repetitive tasks, robots have recently made their appearance also un many other fields. In tourism, and mainly in hospitality, the first implementations concern humanoid machines (robots that have a body shape built to resemble the human body). They have been deployed to provide information to guests, front desk services (check-in and check-out), storage or delivery services, using technologies including voice and facial recognition and several machine learning algorithms that support recommendation systems (Ivanov et al., 2019).

Internet of Things (IoT) has become a common term for indicating the wide array of environmental sensors and actuators or other devices endowed with some communication capabilities and connected through the Internet, often via cloud services. In the tourism and hospitality domain IoT systems are spreading, and used for several purposes. In a hotel, for example, it is possible to personalize all the environmental settings in a room (temperature, lights, water flows etc.), to control accesses, or to check the operational status of different devices and appliances for predictive repairs and maintenance. In a destination IoT devices can track visitors and help managing flows or deliver location-based information and provide guidance to tourist about transportation, attractions, tours, shopping, hotels (Wise & Heidari, 2019). Besides a pure recording, a wise application of machine learning algorithms allows to use IoT assemblies for optimizing or managing automatically many processes. This is, without doubts, an essential aspect for ensuring the construction and the development of a smart destination (Mahdavinejad et al., 2018).

Even if not exactly IoT, we can also add to the list the different implementations of mixed reality, the combination of the twin technologies of virtual reality (VR) and augmented reality (AR). This is the 'blending' together of real and virtual objects, where virtual elements are positioned and aligned in order to appear as part of the real world with respect to the user view. Beyond gaming and entertainment, many useful applications have been and continue to be implemented also in the tourism domain where they can provide layers of information and suggestions to tourists improving their local experience (Sanna & Manuri, 2016; Yung & Khoo-Lattimore, 2017).

Blockchain

Blockchain technology is one of the most talked about technologies today. Digital currencies such as Bitcoin and Ethereum have used this technology and made it popular for their rapid and extensive diffusion. However, and more than that, blockchain is a general foundational technology that is finding a wealth of applications in many different domains (Aste et al., 2017; Zheng et al., 2018).

A blockchain is a list of digital records in packages (called blocks) which are linked and secured using cryptographic techniques; the digital records can transactions, contracts or documents of any nature.

These digitally recorded "blocks" of data are stored in a linear chain. Each block in the chain contains data (e.g. bitcoin transaction), is cryptographically hashed, and time stamped. The blocks of hashed data draw upon the previous-block (which came before it) in the chain, ensuring all data in the overall chain has not been altered thus providing a strong security layer naturally and directly embedded into the system.

Actually, blockchain systems are part of the wider set of *distributed ledger technologies* (DLTs). These are replicated, shared, and synchronized digital databases, geographically spread across multiple sites, countries, or institutions. For their design (based on peer-to-peer networks) DLTs offer significant benefits in terms of efficiency and economics and create a more robust environment for real-time and secure data sharing.

Besides the arrangement in secured blocks, the second component of a blockchain system is a consensus mechanism (protocol) that allows participants in the system to validate the single blocks and insert them into the chain. The rights to validate can be attributed to selected participants (or the organizers of the chain) or rendered 'public' allowing, in principle, any participant to undertake the task. In this latter case, however, experience with the cryptocurrencies that use these methods has shown that when the system grows in operations, the requirements in terms of computing power become incredibly high and only a few 'giant' providers could have the necessary resources. Inside many organizations, however, and especially in the tourism and hospitality domain, the technology is being studied and implemented for its security and efficiency characteristics and is deemed useful for ensuring operational effectiveness and efficiency (Nam et al., 2019; Willie, 2019).

Concluding remarks: putting all together

At the end of this brief overview of the most recent developments in the technologies that are available and continue to advance, some considerations are in order.

The first one is that today the only limit to what is possible to achieve seems to be the imagination and the creativity of those who use them. In particular, for a smart destination, practically all possible interventions can be based on sound layers of computerized procedures. However, it must be noted that, for really successful realizations some important precautions must be taken.

A smart tourism destination is a complex and dynamic ecosystem where all components, digital or *real*, need to be strongly coupled and co-evolve forming a single system (Baggio & Del Chiappa, 2014). This means that the digital component, by itself, is not a sufficient condition for ensuring *smartness*. On the contrary, a digital injection can support the transformation of a tourism destination toward smartness if and only if the physical component of the ecosystem is deeply restructured. That is to say that operational and organizational processes need to be profoundly and rationally redesigned and reengineered.

On the technological side, an important success factor is the possibility to make wide use of the basic infrastructures and to allow room for growing not only in intensity if usage, but also, and more importantly, in the extension of functionalities that can be designed and implemented only on the basis of a continuous monitoring of the uses and of the needs or wishes of all stakeholders involved, including the local population.

This, as seen, can be achieved if the technological layer is designed as an open and inetroperable architecture, in which all the elements, from the data to basic the software functionalities are made freely and openly available to all interested parties, adopting some standardization process that ensures this interoperability.

All stakeholders need to be educated and informed that technologies can ease operations and improve their competitiveness, and that of their destination, only if they support a cultural and organizational change and transform the way they manage their intra and inter-organizational processes and relationships.

Finally, policy makers and destination marketers should persuade stakeholders that a tourism destination is the expression of a collective effort by different actors belonging to different (but interlinked) sub-sectors, that requires a strong attitude to cooperate so that dissemination, transfer and absorption of knowledge can occur smoothly and help increasing innovativeness, attractiveness and competitiveness.

This is a very important issue. As Ingram & Roberts note (2000: 387):

> "*Friendships with competitors can improve the performance of organizations through the mechanisms of enhanced collaboration, mitigated competition, and better information exchange. Moreover, these benefits are best achieved when competing managers are embedded in a cohesive network of friendships (i.e., one with many friendships among competitors), since cohesion facilitates the verification of information culled from the network, eliminates the structural holes faced by customers, and facilitates the normative control of competitors*."

And this effort in cooperation, as the authors show, can also have a sensible monetary value, which is a further argument to support good practices in this regard.

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