DIFFUSION OF INTERNET OF THINGS (IOT) IN SMART TOURISM DESTINATIONS

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Abstract

The rapid evolution and deployment of Information Technologies may produce smart organisations, smart communities and smart destinations. In all levels of decision making in tourism, the basic objective is make the best decisions. Nowadays, tourist software applications have become a technology boom used in all levels of this decision making. This has been amplified by the development of sensors, gadgets and other hardware devices embedded in the environment. The development of Smart Cities has led to the concept of the Smart Tourism Destinations (STD). Tourism destinations could make use of these interactions between ubiquitous sensing technology and their social components to support the enrichment of tourist experiences. The aim of this research is concentrated on the usage and need of what is called as Internet of Things and its effectiveness to achieve Smart Tourism which could deliver the best travel information in real-time based on destination. This is explained using a holistic approach incorporating tour information, and services related to travel, such as destination, food, transportation, reservation, travel guide, conveniently to tourists through accessible channels. At last but not least, results serve to point out major trends and gaps in which to focus further investigations on this topic.

Keywords

Smart Tourism Destinations, Internet of Things, Smart Applications, Travel and Tourism, Technology

1 Introduction

The rapid growth of urban population worldwide has triggered intricate challenges for cities around the world. City infrastructures are facing a massive pressure due to the fact that more than half of the world's population lives in the cities (Falconer, G. and Mitchell, S., 2012). According to new report from the McKinsey Global Institute, *Urban world*: Cities and the rise of the consuming class, finds that the 600 cities making the largest contribution to a higher global GDP—the City 600—will generate nearly 65 percent of world economic growth by 2025 («Urban world», 2012) . As cities become increasingly competitive and complex, Information and Communications Technology (ICT) will coordinate all tourist facilities and services, leading to connected, better informed and engaged tourism communities.

Thanks to establish smart technologies and ICT advancement tourism destinations make more accessible and enjoyable for both residents and visitors through interactive service interconnecting all local organisations to provide real time services and use data centrally for better synchronization. Adopting new technologies can support organizations to confront the challenges of the future (Dwyer & Edwards, 2009) . The advancement of different platforms and wireless connection withstands time and distance limitation which leads to positive coordination and interactions within service providers and visitors in destinations. Besides, these increases support the provision of constant experience to tourists. Correspondently, it enables tourist the exchange of information and creates new possibilities to enhance the real life experience (Racherla, Hu, & Hyun, 2008).

In the Internet of Things (IoT) paradigm, many of the objects that surround us will be on the network in one form or another (Calderoni, Maio, & Palmieri, 2012). A new wave of services is bound to evolve from such smart infrastructure and smart devices that will influence all aspects of our social eco-system. The range of applications would encompass several essential services such as energy, Sanitation, Health Care, Transport, Farming, Governance, Automation, Manufacturing etc. Applications and technologies that can enable services around these capabilities require to be developed. Internet of Things (IoT) supports intelligent Machine-to-Machine (M2M) and Machine-to-User (M2U) communication and the provision of the essential services. A set of such services and the intelligent infrastructure form the basis of what has come to be called as Smart Cities.

An environment where technology is surrounded within the city characterises the notion of Smart City (Buhalis & Amaranggana, 2013a) . The improvement and establishment of Smart Technology in not only push deployment of tourism economic field but also it will synergise with city's social components in order to improve lifestyle inhabitants while also progress city services efficiency, like optimising the use of energy and better traffic monitoring (Vicini, Bellini, & Sanna, 2012). On this basis, societal challenges of community and its tackled issues could be solved by the support of these applications in which integrates monitoring devices, storage devices, analytics tools, visualization platforms and client delivery.

Indeed, the expansion of Smart City also facilitates seamless access to value-added services both for its citizens and tourists as city visitors, such as access to real-time information on public transportation network. Further, Smart City has enable interconnectivity among city stakeholder through Internet of Things which allows cities to dynamically engage with their stakeholder (Vicini et al., 2012). The radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world

(actuation/command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications and communications. *Figure 1* where the application domains are chosen based on the scale of the impact of the data generated. The users span from an individual to national level organizations addressing wide ranging issues.

Figure 1. *Internet of Things schematic showing the end users and application areas based on data*

The innovation of new technologies and usage of them have reformed efficiency of tourism services, by these apps it correspondently proliferated tourism industry. Nowadays, tourism destinations face a set of new challenges arising from modifications in both consumers and the environment as influenced by the emerging new technologies. In order to deal with these challenges, first destinations have to recognise the kind of changes that occurred then proactively respond (Soteriades, 2012). From a global perspective, in the recent years, travellers have changed the way they organize their prior-, during-, and post-tour experience due to massive usage of ICT in sector of hospitality, while also improving efficiency and supporting process automation for the related organisations (Gretzel, 2011) . Hence, the development of Internet of Things (IOT) could also encourage the foundation of Smart Tourism Destinations globally. In the way of providing smart technology circumstances within the destinations environment, it can enrich tourist experiences and enhance destinations competitiveness.

The following paper will tackle the topic of the future of Smart Cities by exploring the Internet of Things and concept of Smart City, and how Internet of Things could be diffused for the deployment of tourism sustainability.

2. Fundamentals

2.1 The concept of Internet of Things (IoT)

Tourism is recognised as a global industry for many territories, which see in it a key source of income and benefits, competing with other places and destinations to attract people and businesses (Buhalis & Amaranggana, 2013a).

The diffusion of the Internet of Things (IoT) is rapidly establishing in the emerging world of ICT. The term IoT was firstly created by Kevin Ashton (MIT) in 1999. He indicated IoT as a network tool that connect anything in anytime and anyplace in order to identify, locate, manage and monitor smart objects (Mingjun и др., 2012). The concept of IoT is directed to generate automatic real-time interactions among real world objects connected to Internet which consequently also diminish the gap between real world and digital realm (Buscher, Tomordy, Ashley, & Tabet, 2010).

Besides, the deployment of different mobile platforms have also supported the development of the plethora applications by which namely combined visual tagging of the visual objects and different devices that contributed to the advancement of IoT (Borrego-Jaraba, Garrido, García, Ruiz, & Gómez-Nieto, 2013). In addition, the accessibility of IoT make able to transmit range types of data using a participatory sensing systems (Gutiérrez и др., 2013). The usage of mobile devices to explore destination and events of interest using in-situ data collection and reporting, simplifying real time data network connections and making easy to keep in touch with tourist services, online info boards could prove the enrichment of IoT in travel and hospitality sector.

The travel and hospitality industry enriches tourist services by incrementing real time in-situ information on events, weather conditions, services etc.

Therefore, in order to get use of these activities in tourism destinations, multidimensional set of data which known as Big Data could store observed massive size of digital traces. By managing Big Data, tourism DMOs could extract valuable insight from avalanche of information that could uplifts them to a new dimension of customer experience and improves the way they interact with tourist and suppliers (SOCAP International., 2013). As service sector is one of the major global economic field, the new innovation technologies like IoT and Big Data could lead to open new world of opportunities for the tourist destinations. Moreover, by the establishment of these applications suppliers of tourism businesses have possibilities to gain an abundant competitive advantage compare to competitors. On this basis, travellers and local people who surrounded with these services, consume fundamental information which is provided and delivered to make better decisions for further economic purposes of the touristic businesses.

2.2 Smart cities

The usage of ICTs in the tourism sector is significant enrichment in order to provide upgrade service effectiveness and segregate management DMOs, Smart tourism destinations as well (Egger, 2013) . Although there are obvious factors that justify the introduction of smart cities, they are not really taking off and not truly realizing the projected potentials. The idea behind a Smart City is that in the current digital age, not only physical infrastructure sand endowment of a city illustrate an urban area and its functions, but something less ‘hard’ and

not so easy to identify, as quality of knowledge communication and 'social infrastructure', or social and intellectual capitals (Murgante & Borruso, 2013).

The need for affordable housing, traffic congestion, the rising energy costs, water scarcity, and environmental targets or regulations are strong enough reasons to justify the concept's introduction (Vilajosana et al., 2013).

Smart cities concept has typically been associated to technology embedded ecosystem that addressed to build interactions with their social components in order to enhance citizens' quality of life and to improve the efficiency of the city services (Egger, 2013) . In some sustainable tourism destination deployment, the concept of Smart City arises, as a device or, better, as a framework where 'traditional' urban production factors are coupled with the social, cultural capital, by means of a massive use of ICTs.

The sustainable economic growth and high quality of life were achieved through investment in human capital, adequate level of government participation and infrastructure that support proper dissemination of information throughout the city could categorise as smart city.

Setting growth beyond organic growth rates has following dimensions today:

- ✓ *A political dimension, calling for an establishment of smart city DMOs (departments)*
- ✓ *Establishment of transversal and interoperable technological platforms to manage the huge amounts of data generated (Big Data, Open innovation, Crowd, Cloudsourcing and etc.)*
- ✓ *A financial dimension, calling for a coherent self-sustainable business model* (Bakıcı, Almirall, & Wareham, 2013)

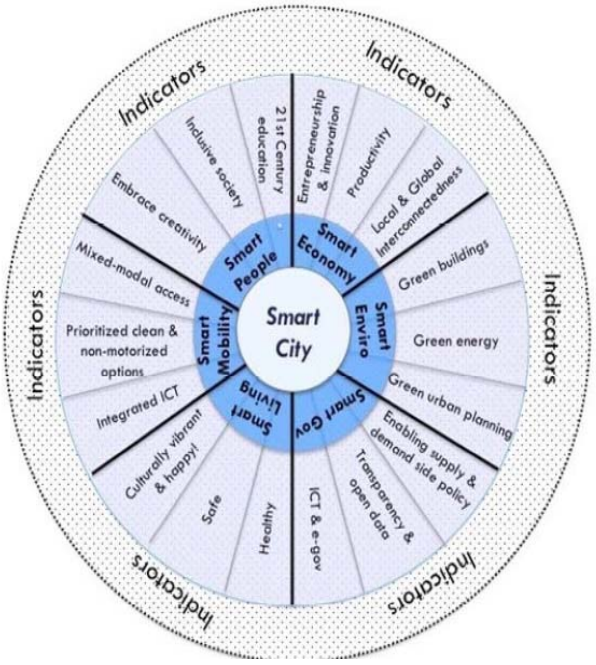
The interactions between the private sector and the smart cities ecosystem have been fairly complicated, which have grown over centuries. One often observes that when it comes to decision making, ownership, decision making, and responsibilities are heavily intertwined. It has hence become clear that the entire decision and execution process within smart cities needs to be institutionalized, and many cities have indeed commenced forming their own "*smart city DMOs (departments)"* with their own decision making infrastructure and procurement processes. The important sustainable smart city destination development is simplifying complexity of public sector procurement regimes by addressing to new technologies, and hence is too expensive and time-consuming for the new ecosystem of high technology companies to engage with. On this basis, the role of organization that makes better decisions for the deployment, integration and modernization of policy is imperative.

The boom of IT in the form of cloud computing and open service delivery platforms has been led key industry and service sectors being part in the industrialization processes. In the past years, new ecosystems of start-ups that provide innovative services and deliver new applications and solutions for different smart city areas have been emerging. The usage of these platforms in tourism & hospitality area will strongly influence the deployment of smart city infrastructures and its facilities.

This has triggered Cisco, IBM, Telefonica, and other global ICT players to launch their respective smart city platforms in order to integrate their own and third party services (Ronay & Egger, 2013). Immense stored data from different platforms and users of these devices becomes information, information becomes knowledge, and knowledge becomes

understanding. In order to open new doors of opportunities, DMOs need to manage and restore the huge amounts of data, through transversal and interoperable technological platforms. Big Data, as a productive use of data in units of measure that far exceed megabytes and gigabytes, provides mind-boggling transformational possibilities for the companies offering hospitality, travel and tourism (HTT) products and services. The HTT sector is an inherent data generator, creating millions of records about travel behaviour on a daily basis. In the past, HTT data has largely been transaction based: Booking reservations, recording account balances, tracking points in loyalty programs. Customer engagement took place on these well- defined but fairly proscribed fields of play. Big Data elevates the HTT sector to new dimensions of customer care by not just managing transactions but by shaping the potential for interactions.

Concerning the financial dimension, it is possibly the biggest factor preventing meaningful smart city deployments. The smart city market, in the sense of instrumenting, interconnecting, and making it more intelligent, clearly has enormous potential but, as of today, is need to be more investigations. From another perspective, some domains of the smart city market were very hesitant, despite the fact that others are currently flourishing.



For this purpose, Smart Cities are not only deliberated as the outcome of innovative process but also as innovation networks that empower communities' co-creation for designing smart life (Schaffers и др., 2011).

Therefore, Boyd Cohen in his Smart Cities Wheel model (Figure 2) identifies six key dimensions along which a city can be identified or ranked namely smart economy, smart environment, smart governance, smart living, smart mobility, and smart people which can also be regarded as the six key components that constitute a Smart City.

These concepts are basis on smart combination of endowments and creative yet knowledgeable inhabitants that make sound management of available resources (Buhalis & Amaranggana, 2013b).

2.3 Smart Tourism Destinations

According to McKinsey Global Institute (June 2012), the 600 largest global cities will contribute 65 percent of global GDP growth from 2010–2025. Nevertheless, bringing Smartness into Tourism Destinations requires dynamically linking stakeholders through a technological platform on which information relating to tourism activities could be transform instantly.

This integrated platform is having multiple touch points that could be access through a variety of end-user devices which will support the creation and facilitation of real-time

tourism experiences and improve the effectiveness of DMOs throughout the destination at various levels (Buhalis & Amaranggana, 2013b; Ronay & Egger, 2013). Smart Tourism Destinations take advantage of:

- Technology embedded environments;
- Responsive processes at micro and macro levels
- End-user devices in multiple touch-points
- Engaged stakeholders that use the platform dynamically as a neural system.

The crucial objective is to utilise the system to enhance tourism experience and improve the effectiveness of resource management towards maximising both destination competitiveness and consumer satisfaction while also demonstrate sustainability over an extended timeframe. There some existent forms of hardware and software, which are embedded within hospitality sector, demonstrate as an eventual need for decision making .The existence of ICTs, such as Internet of Things (IoT), Cloud-Computing, End-User Internet Services make easy to set-up Smart Tourism Destinations in global view.

The use of IoT may support information and data analysis about traveller's behaviour, attitude, and interest and so on. As a result, regional tourist management organisations could make easy decisions that addresses in order tackle that issues. Secondly, the use of Cloud Computing is going to reduce fixed costs and shift them into variable costs based on the necessities (Ronay & Egger, 2013).

It also supports to acquire data, without being actually installed on any hardware devices. The third factor of a smart destination is the End-User Internet Service System, which refers to number of applications at various levels supported by combination of Cloud Computing and IoT. Already established "LIVE" project, which concerns on the creation of innovative hub for electrical vehicles, is one of real example of this component.

On this basis, in order to establish this project some crucial measurements are considered as an important component of Smart City Framework. Most cities actually undergo this process in an intuitive way rather than in a clearly structured manner. A structured method not only will enable efficiencies in city infrastructures, but also transparencies into how cities work.

City leaders define actions or initiatives by their impact on stated city objectives. This is why the proposed Smart City Framework (see Figure 3) starts with city objectives as its base, against which all initiatives are then measured.

Figure 3. Smart City Framework Layers (from bottom to top).

Source: Cisco IBSG, 2012

The four layers of the framework provide a logical flow that enables stakeholders to "push" through and test initiatives (Vilajosana et al., 2013). For example, let's say a city leader is keen on promoting sustainability, which later becomes a high-level objective within Layer 1.

And, let's assume that the city has identified via international transportation indices that its bus system travel times are not ranked high (Layer 2). Given this information, stakeholders can then discuss a city initiative for a "connected bus fleet" (Layer 3) and requirements for designing and implementing the system. From there, city leaders can seek out best practices of similar initiatives worldwide: how such a system was financed and operated, and the policy and regulatory frameworks necessary for success (Layer 4).

The circular flow of information within the Smart City Framework results in a feedback loop that enables stakeholders to understand best practices of other Smart City initiatives. Consequences may lead to some major essential variations after have been implementing Smart City Framework in the area (Falconer, G. and Mitchell, S., 2012).

- ✓ *Taxonomy/typology* that enables cities to benchmark relevant content based on the hierarchy of physical city components
- ✓ *Stakeholder* roles that define who does what. Unfortunately, this part is missing from many city discussions; its omission creates a lack of understanding in how to implement Smart City solutions.
- ✓ *Catalogue system* of city content that is easily accessible

These outcomes will enable cities to:

- Customize a Smart City blueprint
- Identify where and how to implement ICT solutions in cities
- Develop government policy guidelines for enabling private-sector participation in city projects

- Conduct a city gap analysis that enables cities to benchmark themselves, consistently and accurately
- Create a structured case study template for collating multiple business models for similar Smart City initiatives

The gaps among different sub-sectors of tourism may be filled through Smart City procedures while establishments impact positively to get rid of some shortcomings of the hospitality and tourism field of economics.

3. - Smart Tourism Applications

Smart Tourism Destinations should also perform smartness by implementing appropriate tourism applications within Smart Cities' components as defined by Cohen (2012). A range of smart services can be seen on Figure 4, which shows how 6As Destination Components (representing destinations element) and Smart Tourism Destination Dimensions as derivate from Cohen's Smart City Dimensions (representing smartness element) could be combined and possibly generate tourism applications with each of its utility function to be implemented in Smart Tourism Destinations.

No	Tourism applications in smart tourism destinations	Utility function	Destination components (Buhalis 2000)	Smart tourism destinations dimensions (Cohen 2012)
1	Augmented reality (AR) enables visitors to experience digital recreation of tourism sites and time travel (Chillon 2012)	Interpretation	Attractions	Smart people, smart mobility
2	Vehicle tracking system provides a real-time information of transport network and could be distributed to end-user devices (Arup 2010)	Planning	Accessibility	Smart living, smart mobility
3	Hotel should able in predicting energy demand for building and perform energy audits based on their environment management (Metric Stream 2013)	Sustainability	Amenities	Smart environment
4	A multi-languages application that provide range of services such as electronic travel guide which also offer numbers of available packages for tourists (Jordan 2011)	Guidance	Available packages	Smart people, smart mobility
5	NFC tags and QR codes to access information about nearby points of interest through mobile devices (GSMA	Proximity marketing	Activities	Smart mobility

	2012)			
6	Tourists are able to register their complaints through a Complaints Management System that supported by various ICT channels such as SMS or mobile applications which could directly route them to appropriate officials (Metric Stream 2013)	Feedback	Ancillaries	Smart living

Progressing towards the smartness concept, Stockholm collects real-time information from scattered sensors in the city and processes them in order to provide accurate city information through end-user devices; which reflect the use of ICT as a predictive tool to implement a smarter way of managing Tourism Destinations (Achaerandio et al. 2011).

Broadly foreseeable changes caused by smartness immersion in tourism destinations build characteristic of Smart Tourism Destinations, though it triggers different outcome for each stakeholders as summarised in *Figure 5*.

Figure 5. Smart tourism destinations characteristics

- Local tourism organisations
  - ✓ Function as smart hub that coordinates all relevant information and makes it easily accessible for users to access real-time information
  - ✓ Digitisation tour services
  - ✓ Minimise their energy use
  - ✓ Cooperation with local communities, tourists and government in co-creating tourism experience
  - ✓ Organisational agility, speed decision making and responsive to customers' needs based on just-in-time insights
  - ✓ Precision targeting and personalised service
- Government
  - ✓ Information management that support data openness
  - ✓ Regulate data privacy of clients
  - ✓ Establish Public–Private Partnership
- Local residents and local communities
  - ✓ Permanent connectivity
  - ✓ Sufficiently technology savvy
  - ✓ Actively involved in smart heritage advancement
- Tourists
  - ✓ Active critics and buzz marketers
  - ✓ Surfing constantly through social media
  - ✓ Utilise end-user devices in multiple touch-points
  - ✓ Involved both socially and technologically
  - ✓ Co-create experience
  - ✓ Well-connected and well-informed

✓ Contribute to content
• Environment ✓ Interoperable social platforms ✓ Sensor networks throughout the environment ✓ Combine digital information and social contexts ✓ Presence of cloud computing services ✓ Interconnected through Internet of things

Regardless to say, creating Smart Tourism Destinations from scratch requires leader to constructively engage with local to ensure community participation and also regularly monitor the plan. The usage of these feature, tourism destinations get lots of promotion in order to deploy tourism industry and infrastructure of the area. It results to push tourism services in the cities while citizens of that area also get advantages as a constant user. The advancement of services may increase attractiveness of the destinations with innovative activities.

The flagship of the transformation to Smart Tourism Destinations is destination-wide access to real-time information. To achieve this, destinations must undertake open access through integrated public controlled operating systems to offer unrestricted data to all citizens and avoid vendor monopolies (Zygiaris 2013).

Tourism authorities should ensure that any information generate from every development of new application should be made openly available subject to their commercial and legal agreement without unreasonable additional cost (Reischl 2013). There are two main information sources: (1) information coming from the city resulting from sensors, city elements and Open Data; and (2) information coming from the citizens and visitors as digital footprint from their social media activities. Users could use this information to identify problems as well as customised potential solutions to overcome those problems. To maintain rapid growth of technology, it is suggested that Smart Tourism Destinations are best use Living Labs methodology as tools for learning, conducting tests and research before the implementation of new technologies and services in large-scale real-life environments.

Although tourism often incorporates elements of spontaneity and exploration, seems that tourism industries in general are assuming that uncertainty reduction is preferable. In fact, tourists might actually seek out risk and opportunity to get lost and explore. To this end, some intelligent systems are now being developed in accordance to stress the importance of inspiring rather than precisely matching tourists' preference (Mahmood et al. 2008 as cited in Gretzel 2011).

4. - Further Developments

Implementing such kind of Smart technologies, brings a significant change in smart tourism destinations, particularly in terms of improved communication and information services, as well as offering the potential to provide travellers with the necessary information to better manage and utilise their surroundings and touristic resources. With the rapid increase in the presence of Internet of Things (IoT) and future internet technologies in the smart cities context , a large amount of data (Big data) is generated, which needs to be properly managed and analysed for various applications using a structured and integrated ICT approach.

The structured approach can be based on a generic process identifying the necessary steps to be followed by using different techniques, tools and services. These steps may consist of collection, storage, harmonisation, processing, visualisation, analysis and generation of smart city application specific information and knowledge for decision making using Cloud-based storage and analysis services.

Similarly, these innovative tools provide the urban planners with the necessary intelligence for decision making needed to actively manage the urban environment. Moreover, processing and integration of cross-disciplinary data is needed to get knowledge and intelligence for the destination improvement, like sustainability, resilience and governance of a city could be real example of this issue. Smart technology diffusion would provide the necessary context-aware information services for both general public such as public transport services, air quality of surrounding environment and tourism boards, DMOs as well. In addition, inhabitants can also participate in aggregation of information through Crowdsourcing, Big Data and related technologies from various infrastructures and sub-sectors of hospitality sector. Such public participation empowers to strengthen tourism potential and leads national brand to be well-known, which can result in behavioural changes for green and sustainable healthy city-wide initiatives.

5. - Conclusions

As tourism destinations become increasingly competitive and complex, Information and Communications Technology (ICTs) is critical for coordinating all activities and services before, during and after visitation. Connected, better informed and engaged tourists interact dynamically with the tourism industry to co-create their tourism products. Interconnecting all local organizations can enable them to provide real-time services and using data centrally for better tactical and strategic management at the macro and micro level. The concept of Smart Destinations demonstrates an environment where technology is embedded throughout the destination, facilitating its dynamic coordination, empowering its marketing and developing its competitiveness. A destination could be categorised as smart when sustainable economic growth and high quality of life and tourism services are obtained through investment in human capital, adequate level of government participation and infrastructure that support proper dissemination of information throughout the city. Thus smart destinations should base fundamental components such as human capital, required tourism infrastructure, establishment of information technologies and so on. Smartness of tourism cities will be authorized by number of critical modifications that generate paradigm shift. On this basis, Internet of Things, Machine to Machine collaboration, Big Data, Ubiquitous Networking, Networking Business, Context Based Services and other innovation technologies are well-connected in the criteria of making Smart Cities. Proper establishment of these technologies and accurate set-up steps make new paradigm around real time consumer centricity and co-creation. The objective of this paper was to explore the factors that will enable smartness of tourism destinations through theoretical framework to ensure the optimization of value for all stakeholders. This investigation identified some factors and catalysts that could increase smartness of destinations, explored competitiveness promoters for both suppliers and DMOs, elaborated value of user-generated content, and suggested components of Smart City frameworks in the tourism industry. Smart Tourism Destinations cored in massive tourism resource data centre, supported by Internet of Things and Cloud Computing, focused on enhancing tourists experience through intelligent identification and monitoring. The real sense of Smart Tourism Destinations is to focus on tourists' needs by combining the ICT with

casual culture and tourist innovation industry in order to promote tourism service quality, improve tourism management and enlarge industry scale to a broader extent (Huang et al. 2012). While this paper has shed some light on the topic, case studies approach might be suitable to further investigate best practice of Smart Tourism Destinations implementation and to generate more in-depth understanding within this subject. Further research is needed to expand the theoretical contributions of this research as well as to validate the findings.

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