

Information and Communication Technology for Sustainable Tourism Development

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ICT for Sustainable Tourism Development
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Abstract

The role of ICT for sustainable tourism development is discussed in this chapter. The tourism industry is experiencing a sustainability crisis. Mounting evidence exists on the detrimental impacts created as a result of tourism activities such as overcrowding in destinations and accelerated production of carbon emissions. Research in sustainable tourism is mature but challenges still exist in its operationalization and addressing the consequences of tourism on the economic, socio-cultural and natural environments. Therefore it is critical that eTourism researchers focus their attention on how ICT can be of critical significance in addressing sustainability issues. This chapter first examines the relationship between ICT and sustainable tourism and subsequently focuses on ICT role in sustainable tourism for destination planners, tourists and local communities. The specific ICTs used by each of these aforementioned groups are expanded upon. Detailed attention is given to how destination planners can position ICT for achieving the sustainable development goals. The chapter concludes by looking at the critical success factors of the effective implementation of ICT for sustainable tourism development.

Keywords

ICT, information and communication technology, sustainable tourism, eTourism, destination management, sustainable development

Introduction

Tourism's lucrative financial prospects position this industry as a cure for the economic and developmental dilemmas of many countries (Saveriadis 2000; Pforr 2001; Andereck et al. 2005, Negrusa et al. 2015). This is evidenced yearly through the increasing number of arrivals and the growth of the diversity of the tourism offer ranging from new destinations and innovative experiences to facilitate changing consumers' needs and requirements. Both the academic literature and industry continue to debate extensively responsible approaches to harmonizing this viable economic growth with the natural and socio-cultural environments through operationalizing the concept of sustainable tourism development. For this chapter, sustainable tourism is understood as a positive, comprehensive and integrated approach to tourism development which involves resource management and working together with stakeholders for the long-term viability and quality of the social, economic and environmental resources (Hunter 1997; Miller and Twining-Ward 2005; Ayuso 2007). Sustainable tourism is considered a moving process towards fulfilling the larger goal of sustainable development. Achieving sustainable tourism is not the end outcome but rather it is seen as a progressive goal which changes as the tourism system and the wider environment in which tourism operates transform (Swarbrooke 1999; Lee 2001; Higgins-Desbiolles 2018).

It is imperative that the tourism industry finds equilibrium between the level of economic growth and preservation of the environment (Ali and Frew 2014) as continual expansion is not compatible with the goals of sustainable development (Higgins-Desbiolles 2018). These steady increases of tourism undeniably places stress on the natural assets and cultural heritage of destinations which has resulted in irreversible, negative impacts. However, these resources have great potential for sustainable growth as they are the assets for human development, drivers of the economy and creation of jobs (Rignati 2017). Despite the significant attention being paid to the sustainable development of tourism, globally, the industry is less sustainable than it has ever been (Hall 2019). As the entire tourism

industry's future is dependent on the well-being of all aspects of the environment, workable solutions are necessitated to ensure its sustainable development.

Information and communication technologies (ICT) have been promoted as a recent approach for achieving sustainable tourism development (Ali and Frew 2013; Gössling 2017; Rignati 2017; Benckendorff, Xiang and Sheldon 2019). This is because ICT is creating opportunities for significant sustainable changes from both technical and consumer engagement perspectives (Bull 2015; Negrusa et al. 2015). It is undeniable that ICT has penetrated the way we work and live and is now firmly embedded in our lives. Emerging technologies such as robotics, artificial intelligence and the Internet of Things have activated the fourth industrial revolution which integrates the physical and the digital worlds (Gorbenko et al. 2018). ICT is also often seen as the solution for development in areas such as poverty alleviation, economic growth and improving the capability and livelihoods of local communities (Novelli and Hellwig 2011; Henriques and Brilha 2017; Gouvea, Kapelianis and Kassicieh 2018). It offers solutions to new or existing challenges (Vargo, Weiland and Akaka 2015) because it provides us with the scholarship and understanding to create, advance and connect with sustainable practices.

The relationship between ICT and sustainable tourism is definitely a tenable one. Tourism needs new technologies to support sustainable tourism development. This chapter focuses on the role of ICT in sustainable tourism development for tourism's main stakeholders: destination planners, tourists and local communities. These relationships are considered from the destination development and management perspective as ultimately this is where the strongest influence for enacting a destination's sustainability will come from due to resource availability and capabilities the engage with these ICT. In doing so, the ICT-sustainable tourism relationship is positioned to demonstrate how some of the sustainable development goals (SDGs) can be achieved for tourism (UNWTO 2017) with the help of ICT. The aim of this is to focus the reader on the value of these technologies rather than the actual technologies per se for sustainable tourism development. In the context of this discussion, ICT is the overarching term which refers to the range of innovate technologies which comprises an integrated system of software and networked equipment utilizing databases, communication devices and the Internet for information flow, sharing and processing.

ICT and sustainable tourism

Higgins-Desbiolles (2018) argued that the tourism industry continues to promote growth at the expense of the natural and socio-cultural environments and that such an approach is misaligned with the goals of sustainable development. An extreme approach would be to reduce the growth of tourism by limiting travel and tourist numbers. However such a suggestion would not work in reality because of the psychological need for travel and the social cultural learning which comes from travelling. Additionally many economies are dependent on the income generated by the tourism industry. Developing a deeper understanding of the relationship between ICT and sustainable tourism is of critical significance for tourism's continued success because through ICTs opportunities are created to maximize the benefits whilst decreasing the negative impacts of tourism development.

Tourism developers are continuously faced with many challenges and decisions regarding the proper planning and developing of their destinations relating to sustainability. In identifying tourism's role in achieving the 2030 SDGs, the UNWTO and UNDP (2017) have also recognized the critical importance of ICT in creating an enabling, sustainable future for tourism. This synergistic relationship between ICT and sustainable tourism offers organizations a way of improving the management of the economic, natural and socio-cultural environments (Ali and Frew 2013; 2014). These researchers further elaborated that ICT can be used to manage and provide more useful information for the mapping and monitoring of the economic impacts leading to economic sustainability. ICT can also be used to manage and control development, identify sensitive areas, spread the distribution of tourism and

provide quick accurate and up-to-date information for decision-making leading to environmental sustainability. Local communities can be offered a way to protect and preserve their culture and heritage and engage in the tourism development process thereby leading to socio-cultural sustainability through the use of ICT (Rega and Inversini 2016). Protecting cultural and heritage attractions can also be realized through the positioning of ICT (Schieder, Adukaite and Cantoni 2014).

The research on the role of ICT for sustainable tourism is still in its infancy but ICT importance is well-established. The annual ENTER conference organised by the International Federation for Information Technologies in Travel and Tourism (IFITT) must be recognized as in recent years attention has been paid to extending our understanding of this topic. This has progressed from a conference track in 2010 on ICT and sustainable tourism to the entire 2020 conference being dedicated to the theme of responsible eTourism. Key topics discussed on ICT for sustainable tourism at ENTER are how ICTs can be used by destination management organisations (Ali and Frew 2010), the in-trip ICTs which tourists can utilise (Scott and Frew 2013), conceptualization of the concept of eTourism for development (Inversini, Rega, Pereira and Bartholo 2015) and its application to community-based tourism micro enterprises (Gan, Inversini and Rega 2018), the use of technology in cultural and heritage attractions (Schieder, Adukaite and Cantoni 2014; Tscheu and Buhalis 2016), smart tourism destinations (Boes, Buhalis and Inversini 2015), virtual reality, (Disztinger, Schlögl and Groth 2017), tracking tourism behaviour (Kellner and Egger 2016) and artificial intelligence (Tussyadiah and Miller 2020). There are several other noteworthy publications on the relationship between ICT and sustainable tourism (see for example Liburd 2005; Ali and Frew 2013, 2014; Budeanu 2013; Scott and Frew 2013; Gössling 2017; Benckendorff, Xiang and Sheldon 2019; Gössling and Hall 2019).

A comprehensive compilation of ICT and their associated uses for all the different facets of sustainable tourism was elucidated by Ali and Frew (2013). These researchers demonstrated how ICT can be practically engaged in destination management. Building on this, Benckendorff, Xiang and Sheldon (2019) utilized the twelve aims of sustainable tourism developed by UNEP and WTO (2005) as a framework for discussing the constructive relationship between ICT and sustainable tourism. Through connecting the goals of sustainable tourism, these authors examined how ICT allow more accessible information distribution for decision making and monitoring of environmental resources as it improves the economic, environmental and socio-cultural awareness. Therefore ICT offer hope and renewed insights for dealing with the challenges of sustainable tourism.

ICT and the sustainable tourism planner

Destinations are challenging to manage because inherently they are complex systems with many inter-related components, sectors and sub-sectors and a diversity of stakeholders who compete and cooperate. The natural environment is a key ingredient for travel. It is not only the backbone of the tourism industry but our entire existence hinges on it. ICT can be effectively used by tourism decision makers to maintain, enrich and prevent degradation to the land ecosystems, marine resources, biodiversity and natural heritage sites. This maintenance, preservation, conservation of and respect for the environment through ICT can allow tourism to contribute to the SDGs through combatting climate change, protecting and conserving the coastal and marine environments and the ecosystems and biodiversity.

Computer simulation can help destination managers plan their tourism development. Such technology reproduces real world systems to model planning conditions to determine possible future outcomes based on current decisions. Such scenarios are too complex for direct observation (Wang and Manning 1999). These simulations can be designed to depict how the environment can change over time and the resultant impacts and interactions with other critical components of the system allowing for more informed decision making. Visitor usage patterns and capacity issues can be determined and monitored using computer simulations (Lawson 2006) which allow a planner to recognize threats and

opportunities to the tourism system especially around issues of capacity and demand. There are several approaches to using simulation for tourism development such as systems dynamics and agent based modelling. Both of these approaches are used to represent complex systems such as tourism. With system dynamics, researchers deconstruct multifaceted social or behavioural systems into their separate elements to observe this behavior over time; this is then integrated into a whole for visualisation or simulation (Bieser and Hilty 2018). On the other hand, agent based modelling, focuses on simulating the outcomes of individual agents' behavior due to engagement with each other and the environment based on a set of defined rules (Nicholls, Amelung and Student 2017). These agents combined behavior shapes the behavior of the system (Bonabeau, 2002). Examples of these agents are tourists, the local community and the natural environment. Ding, Gong, Li and Wu (2018) categorise system dynamics as top-down and agent based modelling as a bottom-up methods.

Systems dynamics has been used by Carlisle, Johansen and Kunc (2016) to represent and strategically plan Bournemouth's urban coastal system. In the Galapagos Islands, system dynamics was applied by Pizzitutti et al. (2017) to scenario plan the implications of tourism development on natural and socio-cultural environments. Sedarati, Santos and Pedro (2019) advocated for the use of system dynamics in tourism planning and management for better comprehension of tourism's complexities in order to allow for more effective practices. Nicholls, Ameling and Student (2017) identified that agent based modelling can be valuable for tourism planners in understanding tourist motivations and behavior and modelling visitor flows, thus supporting tourism planning and policy.

Geographical Information System (GIS) is another ICT tool which can be used for sustainable destination planning. This is an information system for collecting, storing, retrieving, mapping, manipulating, analyzing, integrating and displaying vast amounts of spatial and non-spatial geographical data (Feick and Hall 2000; Lee and Graefe 2004; Avdimiotis et al. 2006; Chancellor and Cole 2008). Spatial data is critical for the planning and management of tourism (Munro et al. 2019; Avdimiotis et al. 2006) and therefore a GIS serves as a problem solving and opportunity identification decision support system for tourism planners. Through the use of a GIS, spatial knowledge can be combined and managed with other relevant data relating to the environment or the local infrastructure to ensure sustainability concerns are addressed when decisions are made. A resource inventory of an area can be completed to determine its suitability for tourism development by identifying the areas which need protection, establishing how the land use will change over time, the required capacities and establishing the boundaries with the communities (Ali and Frew 2013).

A GIS can also support tourism planners in identifying the appropriate indicators of sustainable tourism and monitoring and measuring these. Eslami et al. (2011) reported that GIS has the capability to determine the impacts of natural disasters and assess the impacts of pollution and climate change. Therefore the strength of a GIS lies in its ability to procure and audit tourism resources to model outcomes and alternatives to make fundamental decisions about sustainable tourism development. It offers an integrated approach to the management of local resources based on the capacity of the resource and the needs to the local communities and the tourists (Bahaire and Elliott-White 1999). In tourism, several studies demonstrate the significance of GIS for tourism planning (see Feick and Hall 2000; Garcia-Ayllon 2016; Prueksakorn et al. 2018).

An advancing technology which extends the capabilities of a GIS is *virtual globes* or *Digital Earth* (Brovelli et al. 2013) as this allows for a richer 3D visualization compared to the 2D of a GIS (Rignati 2017). This technology was inspired by Al Gore who conceptualized a multidimensional computer generated globe for us to gain a greater understanding of the Earth's history and change the way we experience the world through geographic information (Brovelli et al. 2013). Known examples of this include Google Earth, NASA's World Wind and Microsoft Virtual Earth. Virtual globes are democratizing access and content because they are open source and more users can engage, create

and share content (Elvidge and Tuttle 2008). This reduces cost for destination planners as the content is co-created and the technology is easily accessible (Brovelli et al., 2013). Virtual globes are seen as contributing to sustainable tourism, for example through the geo-localisation of heritage (Rignati 2017). Using NASA's World Wind, Brovelli et al. (2013) demonstrated how this technology can contribute to sustainable cultural heritage of two sites by improving awareness of the rich cultural history and improved management of the local resources. According to Rignati (2017) a destination which does not value or preserve its heritage is not sustainable. This technology allows planners to have a historical visualization of how an area changes over time and allows for comparisons for better planning. Due to the open access and availability of virtual globes, it facilitates greater community participation as they can easily add information based on their experiences to inform the planning decisions.

The improving sophistication of *unmanned aerial vehicles (UAVs)*, commonly known as drones, offers new possibilities for sustainable tourism planning. These devices are remotely operated by either a human or via a computer (Bansod et al. 2017) and were designed to imitate the real world such as flies and dragonflies (Schreiber and Ostiarim 2014). They consist of a ground station for piloting, the payload which consist of the sensor and cameras and the flying mechanism and vary in size and weight from a few centimetres to metres (Schreiber and Ostiarim 2014). Drones were originally created to be used in the military but their uses are growing. They can be used to collect rich intelligence to support the tourism planning process. This can be especially valuable in areas which are difficult to reach. This data can be combined with the information from the GIS to provide more accurate representations of the changes to tourism system to support tourism decision makers.

Destination planners can engage with specialist software designed to meet their specific sustainable tourism development requirements. Examples of these are Environment Management Information Systems which allow businesses to track and manage their environmental functions such as waste and emissions. For example, cruiselines are engaging with new technologies to reduce waste and emissions (Cervený, Miller and Gende 2020). Economic Impact Analysis Software enables the destination to understand the economic implications from tourism development. Such software can be stand alone or built into a Destination Management System to aid in the holistic management of the environmental resources required for a healthy and vibrant tourism industry.

ICT for the sustainable tourist

Tourists play a critical role in sustainable tourism because of their consumption behaviors when they are at a destination. Whilst all tourists indicate their support for acting responsibly and being environmentally friendly this rarely happens in reality. This is not surprising given that the consumption of tourism products and services is hedonistic when on holidays as tourists are seeking a different experience to their everyday lives. Therefore tourists require strong incentives to behave sustainably when they are on holiday (Negrusa et al. 2015). Destination planners have a role in educating tourists on their behaviors and impacts to the environment at the destinations and to encourage more sustainable consumption patterns in aiding the SDGs.

Gamification has been identified as an ICT tool which can support this process. As stated by Deterding et al. (2011, p.10) "gamification is the use of game design elements in non-game contexts". Gamification focuses on motivating the user through the use of rewards (extrinsic and intrinsic) and emotions (Robson et al. 2015). Therefore desired behaviors can be learnt and repeated (Burke, 2014). Tourism planners and businesses at the destination can create gamified experiences for the tourist prior to their arrival or at the destination. The purpose of travel is multifaceted but one can hypothesize that tourists visit to create and share new experiences. Tourists can learn about a destination through a virtual gamified experience with rewards, goals and competition built in to encourage sustainable behaviors. The value of gamification for sustainable tourism is the application

of game thinking to stimulate behavior changes (Xu, Weber and Buhalis 2017). Negrusa et al. (2015) observed that through gamification there is a strong possibility that tourists will engage in sustainable behaviors.

Destinations and businesses can play a significant role here in taking advantage of this gaming disposition and connecting both locals and tourists to local goods and services through reward systems. It may be that such a system could incentivize good sustainable behaviors such as using public transport by awarding badges or points with some perhaps tangible benefit such as discounts. Equally, behaviors deemed to be negative in relation to tourism sustainability could be penalised by deducting points. Negrusa et al. 2015 (2015, p.7) describes this as an "artificial ecosystem" which may stimulate tourists to engage in more authentic and sustainable experiences whilst at a destination (Loong, 2014).

Virtual reality facilitates real-time simulation of our senses by allowing a user to visualize, navigate and interact in a virtual computer-generated 3D environment (Guttentag 2010; Yung and Khoo-Lattimore 2017; Beck, Rainoldi and Egger, 2019). Virtual reality can act as a substitute for the actual tourism experience (Guttentag 2010; Mura, Tavakoli and Sharif 2017) as it allows tourists to have a destination experience free of the usual restrictions which lessens the environmental impact (Ali and Frew 2013). The importance of virtual reality for sustainability has been discussed (see DeWailly 1999, Milne and Ateljevic 2001; Teo 2002) but very few studies have been undertaken to demonstrate how this can be achieved. Virtual reality can play significant roles pre-trip and in-trip through educating the tourists on their activities, behaviors and consumption choices related to the natural, cultural and heritage attractions and consumer goods.

According to Slater and Sanchez-Vivies (2016) virtual reality can be used to design the ideal simulated tourist experience. It is difficult to predict if virtual reality can be a replacement for actual tourism but the tenants are present for this to occur. There is evidence that virtual reality can lead participants to having a sense of being whilst having their experiences (Tussyadiah, Jung, tom Dieck 2018). Moyle et al. (2019) observed that akin feelings to being at the destination were gained from a virtual reality experience of the Great Barrier Reef in Australia. Virtual reality provides the opportunity for tourists to sample the culture, history and areas of interest at destinations as a cost effective and environmentally responsible means of travelling without actually visiting the destination (Wiltshier and Clarke 2016). Live streaming and images collected from drones can be used to authenticate the virtual reality experience. Through virtual reality, tourists still have the opportunity to visit locations which they can no longer experience in person because they are highly protected, extremely vulnerable or dangerous (Ali and Frew 2013; Beck, Rainoldi and Egger 2019). Swarbrooke (1999) commented that virtual reality can also be used for socially unacceptable tourism activities such as hunting or sex tourism. It also increases inclusivity as it offers opportunities for visiting a destination for those who might not be able to do so, such as disabled visitors (Hung et al. 2013, Salter and Sanchez-Vives, 2016).

Similar to virtual reality, *augmented reality's* popularity in tourism is growing because it can improve the tourist experience (Hume and Mills 2011; Di Serio, Ibanez and Kloos 2013). Augmented reality is different from virtual reality because it overlays the real world environment with computer-generated information through a device (Guttentag 2010; Jung et al. 2016). With augmented reality, the majority of the information is the real world while with virtual reality the user is totally immersed in a virtual environment (Yung and Khoo-Lattimore 2017). It is acknowledged that augmented reality is a type of virtual reality (Guttentag 2010). In tourism, the research on augmented reality has focused on creating informative and cultural experiences however it has the potential of improving sustainability of the tourism industry (Cranmer et al. 2016). Augmented reality can be of value to cultural and heritage sites in maintaining their sustainability through education and visitor interpretation. Information can be provided about site maintenance, history and heritage, tourist behavior and activities which can

impact negatively and positively. Augmented reality can be used for virtual signage and tourist information which minimises damage (Cranmer et al. 2016). Research has also shown that augmented reality increases a tourist's place attachment (Oleksy and Wnuk 2017; Pantelidis et al. 2018) and therefore tourists are more likely to develop sustainable behaviors.

Mobile technologies can also play a role in facilitating sustainable tourism development (Erdmann and Behrendt 2003; Liburd 2005; Park and Kim 2014; Dickinson et al. 2015) by providing location related information to encourage tourists to make sustainable choices and consume responsibly at the destination. The rapid adoption and diffusion of mobile technologies is fuelling the development of this sector which is accelerating the uses for tourism (Liang et al. 2017). When visiting a destination, geographic information is important in consuming the tourism product from the location of accommodation, food and beverage, sites and attractions. The unfamiliarity of the destination increases the use of mobiles as tourists assimilate information to enhance their experience (Gretzel 2010). Information such as signage, maps, brochures, optimal travel routes and how to consume the natural and heritage assets can be provided to the tourists through mobile phones. For example, Kang and Gretzel (2012) found that listening to interpretative podcasts on mobile phones whilst visiting a national park can increase tourists' environmental stewardship. Carbon calculators can also be included which allows tourists to monitor their emissions levels and further understand their impacts. Such information can sway the tourist decision making and alter their behaviors and movements at the destination (Nielsen and Liburd 2008). Consequently, through the provision of relevant ICT, destination planners have the capability to encourage responsible tourist behaviors.

Social media is an influential communication tool because the trust generated through the content posted by peers (Hijili 2014) is powerful in influencing tourists' decision making (Xiang and Gretzel, 2010). Facebook was found to be a useful medium in connecting tourists' green values and changing their behaviour (Kane, Chiru, and Ciuchete 2012). Batat and Prentovic (2014) investigated the use of social media in three different cultural contexts in endorsing responsible travel and sustainable behaviours whilst Hardeman, Font and Nawijn (2017) observed that online messages to tourist about pro environmental behavior was more persuasive than those given by tour operators. Through social media, Shivya Narth, (travel blogger, <https://the-shooting-star.com/>), publicized a campaign to reduce plastic waste in the Spiti Valley, India. Discarded plastic bottles left behind by tourist were collected and to create the 'I love Spiti' art installation to remind tourist not to use plastic bottles. This initiative led to the installation of water refill stations and local stores no longer sell water in plastic bottles.

Set within the Chinese context, Han et al. (2018) showed that user generated content can propel tourists' to accept their personal environmental responsibility because of increasing awareness of these issues. Since 2018, 'Flygskam' (flight shaming) has penetrated the tourism industry. This refers to someone feeling uneasiness about the environmental impact of flying (Gössling, 2019). There have been social media campaigns exposing celebrities and others for taking long-haul travel. Using netnography on celebrities social media sites, Gossling (2019) demonstrated that celebrities are high carbon consumers due to the volume of travel they undertake. For example, it was estimated that Bill Gates' flights generated >1600 t CO². In the UK, the Flight Free 2020 (<https://flightfree.co.uk/>) campaign has been set up to encourage people to find alternative ways of travelling and creating memorable experiences without flying. Murphy et al. (2018) argued that social media can be used food shaming to educate tourists about their food waste when they are on holidays. From the evidence, it is clear that social media can educate and encourage tourist to have more positive impacts when visiting a destination. Tourism planners can leverage social media as an outlet to disseminate information about the sustainable choices tourists can make whilst on holiday.

Lenzen et al. (2018) identified that tourism is a carbon-intensive industry as its carbon footprint grew four times more than projected to account for 8% of global greenhouse gas emissions from 2009-

2013. At the destination, mobility is important for the tourists and ensuring they have access to sustainable transport options can contribute to fostering a sustainable tourism industry. *Intelligent Transport Systems* (ITS) is the application of ICT and sensor technologies to vehicles and the transportation infrastructure where real-time information from traffic, individuals, independent locations, traffic guidance and dynamic routing is accrued for informed decision making (Erdmann and Behrendt 2003; Ni 2016). The technologies used in ITS can vary but it includes systems such as vehicle navigation, traffic control, traveller information, automated vehicle locations, fleet management and automated traffic management, collision avoidance, traffic light and weather information (Sheldon 1997). An ITS can provide the tourist with rich information about local traffic conditions which maximizes their safety and time (Diagle and Zimmerman 2004; Choudhary 2019). Through the managing and optimising of fleet operations, the ITS offers tourists live travel information at the destination to allow them to co-ordinate their trip more effectively. This can result in more responsible consumption and help tourism contribute to mitigating climate change through reducing its emissions. If tourists have well-designed local transport networks which are accessible, easy to use and provides real time information, they would be more inclined to use.

Whilst tourism planners will not directly design and implement an ITS, they should work with the responsible authority to ensure tourism feeds into this system. This will allow for a more effective transport network at the destination. Such an approach forms the foundation of a smart tourism destination. ICTs have enabled the development of smart tourism destinations as they facilitate real time information sharing, knowledge creation and stakeholder co-operation (Jovicic 2019; Baggio and Del Chappa 2014; Buhalis and Amaranggana 2014). Given the dynamism of the tourism destination, being knowledge-enabled, allows destinations to have better sustainable management of tourism resources (Buhalis and Amaranggana 2014) to create more meaningful tourist experiences (Buhalis and Amaranggana 2015; Gretzel, Sigala, Xiang and Koo 2015).

ICT for sustainable tourism in local communities

Community participation in development has been gaining traction in the literature since the 1970s as it is recognized by leading international bodies such as the United Nations, US Agency for International Development and the World Bank. This is due to the appreciation that community involvement can enact the principles of sustainable development and bring forth transformation to the lives of locals (Hardy, Beeton and Pearson 2002). Ruiz-Ballesteros (2011) argues that some of the communities live in areas of environmental and strategic importance, as these areas are critical in sustaining and balancing the world's ecosystems, hence their significance for sustainable development is undeniable. Communities must be empowered over development activities in their localities so they are able to reap a portion of the benefits which can strengthen their development opportunities. According to Stone (1989) these development initiatives should be designed to ensure the communities are central in making decisions about their needs and how to mobilize their resources to achieve their goals. Hence the community is core to reaping the rewards of tourism development. Tosun (2006) observed that sustainable development occurs when local communities are able to engage fully in tourism.

Communities alone cannot achieve their capabilities but rather various stakeholders have an impact on this. Understanding different stakeholders and their roles is critical to achieving the sustainable development of tourism (Dodds & Butler, 2009, Graci, 2013). Therefore a participatory, multi-stakeholder approach is also crucial in delivering real changes for sustainability. This approach has gained widespread popularity since the publication of Freeman's (1984) text where stakeholders were seen to be critical constituents of an organization's environment. This discussion has penetrated the tourism sphere where numerous researchers have argued that a stakeholder perspective must be considered in achieving sustainability (see for example Murphy 1985; Bramwell and Lane 2000; Waligo, Clarke and Hawkins 2013). This is vital in the achievement of the SDGs as tourism can support

in reducing inequality and creating inclusive societies.

ICT has a fundamental role in empowering local control and providing communities with the opportunities for engaging with tourism. *Community Informatics* can be used as an ICT tool to reach and increase the engagement of host communities in the tourism development process (Milne et al. 2005). Gurstein (2000; 2008) define community informatics as enabling and empowering communities to realize their objectives through the use of ICT. Through the appropriation of ICT, communities can become aware of their capability and develop their commitment to their local resources and skills (Taylor, 2004). According to Milne et al. (2005) the use of ICT for sustainable tourism in communities can lead to democratic participation and representation, advancing their social capital, empowering individuals (especially marginalised groups), strengthening the community and its identity and creation of sustainable community economic development. Community informatics is founded on a grassroots approach and the communities are integral in the use of the ICT for their development (Loader and Keebie 2004; Gurstein 2010). For stakeholders who are not located within the same location, ICT can be used to create 'artificial proximity' and in essence adding and increasing the social capital towards sustainable tourism development (Bystrowska 2017). ICT can also aid in reducing the digital divide by facilitating and transforming communities which may have been disjointed or excluded (Gretzel et al. 2009). In tourism, community informatics have been used in Western Southerland, New Zealand in bringing local communities together through web-raising (Deuchar and Milne 2016), for heritage development in Hearne, Texas (Gretzel et al. 2009) and in the Arctic to develop sustainable tourism approaches (Bystrowska 2017).

Both *computer simulation and GIS* (discussed above) can also be used to involve the local communities in tourism development. These technologies can produce more realistic images, video, sound and data about proposed developments to enable more informed decision making. Such applications endow local communities and allow them to become an important part of the tourism planning process (Ghose, 2001). Participatory approaches with GIS have been used by Hasse and Milne (2005) in Marahau, New Zealand where local knowledge, history and emotions were incorporated into the tourism process. In the Western Solomon Islands, Aswaniet et al. (2015) explored local views about the future environment and society for tourism development through a GIS whilst Munro et al. (2019) acquired local stakeholder knowledge for coastal tourism development in Western Australia via a GIS.

ICT has the power to allow communities to have social equality and achieve sustainable livelihoods. Technology is becoming pervasive and is no longer confined to a particular group of people in society. ICT has eroded the control once held by large tour operators and large businesses with marketing clout. Sustainable development is now positioned in the hands of the community as ICT can connect locals with each other and harness this technology to develop and sell their tourism services to the wider world (Inversini and Rega 2018). These communities now have access to global markets which can encourage entrepreneurialism in developing countries leading to economic growth and innovation (Gössling and Hall 2019). This is also facilitating sustainable tourism through the creation of alternative tourism products such as eco-tourism and volunteer tourism (Inversini and Rega 2018). This engages the tourists with more sustainable forms of tourism whilst simultaneously allowing local communities to have better livelihoods. Nadkarni (2008) identified that ICT enables local communities to organise their resources to produce new knowledge because they now access information on financing, government policies, development of different skills and new networks. Destinations planners can aid in leveraging these technologies for communities and contribute to the SDG of eliminating poverty.

A discussion of ICT for sustainable tourism would not be complete without considering the sharing economy. The sharing economy has been touted as an approach for sustainable development (Heinrichs 2013; Novel 2014; Puouri and Hilty 2018) and in essence sustainable tourism development

(Gössling and Hall 2019). ICT is the mediator which formalised and grew the sharing economy by creating the technological platforms for creating social connections and enabling sharing of resources for an economic exchange. Via the sharing economy, users gain temporary access to a resources and this is provided in return for a cost which can be direct or indirect, monetary or non-monetary. This exchange of products or services requires a provider which can be facilitated directly or through a third party but takes place over a digital platform. Common examples of this for tourism are AirBnB, Booking, Lastminute and VizEat. The sharing economy is typically conceptualized as peer to peer but other forms of involvement can occur such as business to peer, peer to business and business to business (Puouri and Hilty 2018). Kenney and Zysman (2016) call this the platform economy.

In the sharing economy, consumption shifts from owning to access. An AirBnB (2017) study reported that there were significantly lower environmental impacts from staying at their properties compared to traditional accommodation options. The sharing economy contributes to sustainable tourism by optimising consumption patterns through the identification of underused resources (Bostman and Rogers 2011) which can alleviate the pressures on production and consumption and lead to more efficient use of resources and less waste (Palgan, Zvolaska and Mont 2017). Communities can also manage their own tourism development and share their culture. Websites such as mealsharing.com and eatwith.com allow tourists to meet with residents and have a local meal at their home. Toursbylocal.com connects tourists with local tour guides. The hope is that the sharing economy acts as the leverage for sustainable consumption (encouraging new ways of consuming) as sharing is becoming a widespread substitute for purchase and ownership therefore requiring less resourcing (Puouri and Hilty 2018).

Conclusion

It is undeniable that both ICT and the environment are both the lifeblood of tourism (Ali and Frew, 2013). Tourism will continue to magnify and the resultant negative impacts must be dispensed. This chapter has demonstrated the interactions between ICT and sustainable tourism from tourism planning, educating the tourists and supporting local communities. Table 1 summarizes the technologies which can be used for sustainable tourism development.

Table 1: ICT for Sustainable Tourism Development

Tourism Stakeholder	Destination Planners	Tourists	Local communities
ICTs	Computer simulation Geographical information system Unmanned aerial vehicles Specialist software	Gamification Virtual reality Augmented reality Mobile Technologies Intelligent transport systems	Community informatics Computer simulation Geographical Information System Sharing economy
Sustainable Development Goal	Tackling climate change, protecting and conserving the coastal and marine environments and the ecosystems and biodiversity	Encouraging more sustainable consumption patterns	Reducing inequality and creating inclusive societies

Technology will race ahead with new applications and sophisticated uses. The challenge for destinations will be to keep abreast and engage with ICT as part of a broader toolkit for sustainable tourism.

Whilst these ICT hold many hopes for achieving the SDGs for tourism, one cannot forget that there are limitations associated with their use. Ali and Frew (2012) identified a diversity of influencing factors and the necessary conditions for this to be enabled. The critical success factors identified were cost, tourism planners understanding the meaning of sustainable tourism, fitness for purpose, the stage of tourism development at the destination, the users and the consumers. The conditions required were government support, partnerships, accurate data and technology suppliers. These factors still hold true today for the effective implementation of ICT for sustainable tourism.

However two issues must be added to this list. First, technology itself produces negative environmental impacts as there are resourcing costs and emissions associated with its production, use and disposal. Therefore we must also responsibly consume the technologies we are using. The questions which remain are can ICT facilitate sustainable tourism development without becoming a paradox and how clean and green are the technologies we are employing to allow us to have a more sustainable tourism industry? Secondly, the other challenge relates to the digital divide as technology has the potential to exclude communities. Rural areas are the ones most in need of digital connectedness to improve their lives, however, there is a growing rift in the quality of the data infrastructure between urban and rural areas and the level of education and skills (Salemink, Strijker and Bosworth 2017). As such there is low uptake of these technologies in these locations which are most in need of it. The critical factor is how to ensure that those who can reap the rewards of the technologies have the ability to be able to make use of it for meaningful development (Parthasarathy and Aoyama 2017).

To successfully leverage these technologies, tourism planners and businesses must clearly understand these enabling (and disabling) factors for the uptake of ICT for their destinations. This needs to be coupled with detailed comprehension of the current stage of the destination's tourism development and its future developmental aspirations. Ideally, these ICTs should be employed from the start of any tourism development but realistically this is not possible. Engaging with technology for sustainable tourism development is a necessity if destinations want to ensure their longevity but the implementation of this must be considered against the broader backdrop of tourism development and the costs and benefits to society.

Cross-references

Mobile Applications for E-Tourism; Virtual, Augmented and Mixed Reality in Tourism; GIS and Remote Sensing in Tourism; Tourist Tracking Research in Practice; Tourists and Augmented and Virtual Reality Experiences; Smart Tourists and Intelligent Behaviour; E-Supply Chain Management in Tourism Destinations; E-Tools for Tourism Innovation Management – A Typology; Sharing and Platform Economy in Tourism: an Ecosystem Review of Actors; Smart Destinations; Virtual Reality and the End of Tourism.

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