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Technology-driven innovation
Exploiting ICTs tools for digital engagement, smart experiences, and sustainability in tourism destinations

SLIOB   OSSERVATORIO SU SISTEMI
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Introduction

Innovation in tourism destination has received increasing attention in academic and practitioners debate as one of the main drivers of destination competitiveness and development (Gomezelj, 2016; Hjalager, 2010; Ozseker, 2018; Sigala, 2018; Trunfio & Campana, 2019; Zach & Hill, 2017).

Tourism destination, as a complex social system of actors, creates and transforms knowledge into economically rewarding products and forms of innovation (Racherla et al., 2008; Sheehan, Vargas-Sánchez, Presenza & Abbate, 2016; Trunfio, Go & Ferretti, 2012; Trunfio & Campana, 2019; Trunfio & Campana, 2020). It can be interpreted as an innovation ecosystem (Carayannis & Campbell, 2014; Parmentola & Ferretti, 2015), in which specific local contexts matter. Tourism industry pattern, ICTs technologies, and public and private actors (including community and tourists) interactions nurture collective innovativeness and pervasive innovation (Boekema et al., 2000; Roper & Love, 2018).

Innovation in the destination can be considered and interpreted by adopting diverse perspectives and considering various drivers. An integrative theoretical framework interpreted the complexity of the destination's innovation process, identifying pervasive forms of technology-driven and social-driven innovation (Trunfio & Campana, 2020).

Levering on ICTs tools and innovative digitalisation forms, technology-driven innovation introduces new destination models that enhance cultural heritage and creativity values and facilitate sustainable tourism development (Trunfio & Campana, 2020; Trunfio & Pasquinelli, 2021). Institutions, policymakers, and destination management organisations (DMOs) are investing growing resources on digital innovation as drivers of change. The process of technology acceptance and adoption can increase stakeholder engagement in experience co-creation and destination sustainable development. Technologies reshape traditional destination structure in a new smart space in which local community and local firms activated forms of experience co-creation with tourists. The Europe 2020 Strategy, focused on growth and jobs, was framed by the three pillars of sustainability, smartness and inclusiveness which were re-proposed by the 3rd UNWTO Global Summit on City Tourism (in December 2014) as the ground for the "New Paradigms in City Tourism Development". The central idea is that reducing destination imbalances with the unique support provided by smart technologies can facilitate inclusiveness and sustainability, contributing to advancing the United Nations New Urban Agenda, towards the achievement of the 17 Sustainable Development Goals. Goal 11, in fact, refers to "Mak[ing] cities and human settlements inclusive, safe, resilient and sustainable" (UNWTO, 2018) and tourism must contribute to this.

Introduction

Although academics and policymakers worldwide recognise the disruptive power of technology-driven innovation, the understanding of factors, actors, and mechanisms of technology-driven innovation in tourism destinations remains in its infancy.

This exploratory research aims to contribute to the debate on technology-driven innovation in tourism destinations by investigating how destination management organisations can lever on ICT tools to enhance combined forms of stakeholder engagement and experience co-creation and to drive destination towards sustainable development. It cross-fertilises different theoretical domains (Eisenhardt et al., 2016; George et al., 2016): digital engagement, experience co-creation and sustainable tourism development. While their intertwining remained largely unexplored in the literature, national and international practices of destination management suggest not only the pervasiveness of ICT tools as a common thread of local tourism system innovation, but also the opportunity to exploit the potential of the ICTs as pivot across the different domains of application (such as stakeholder engagement, experience co-creation and sustainable destination management). Accordingly, a practice-oriented approach was adopted to develop this research which provides an explorative investigation of the ICT tools adopted in international and Italian destinations, in order to reflect on the state-of-the-art and potential technology applications for destination management.

1. Technology-driven Innovation in Tourism Destinations

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Tourism destinations are smart innovation ecosystems (Carayannis & Campbell, 2014; Ferretti & Parmentola, 2015) in which geographical proximity generates cross-sectorial knowledge (Ozseker, 2018; Racherla et al., 2008; Roper & Love, 2018; Trunfio & Campana, 2019, 2020) driving pervasive innovation and positive spill-over effects (Flagestad et al., 2005; Pique et al., 2019; Tuli et al., 2019; Van Assche et al., 2013).

An integrative framework (Figure 1) summarises the innovation process in the tourism destination. It identifies a complex actors' system in which destination management organisations (DMOs), institutions and political actors, local firms, local community, including tourists interact with the support of two platforms (ICT-infrastructures and social capital). It allows to create, share and transform knowledge, experiences, and resources into pervasive social-driven or technology-driven innovations (Trunfio & Campana, 2019, 2020), such as sustainability and smart destination, digital engagement, and experience co-creation.

Figure 1. Drivers and technology-driven innovations in tourism destinations.
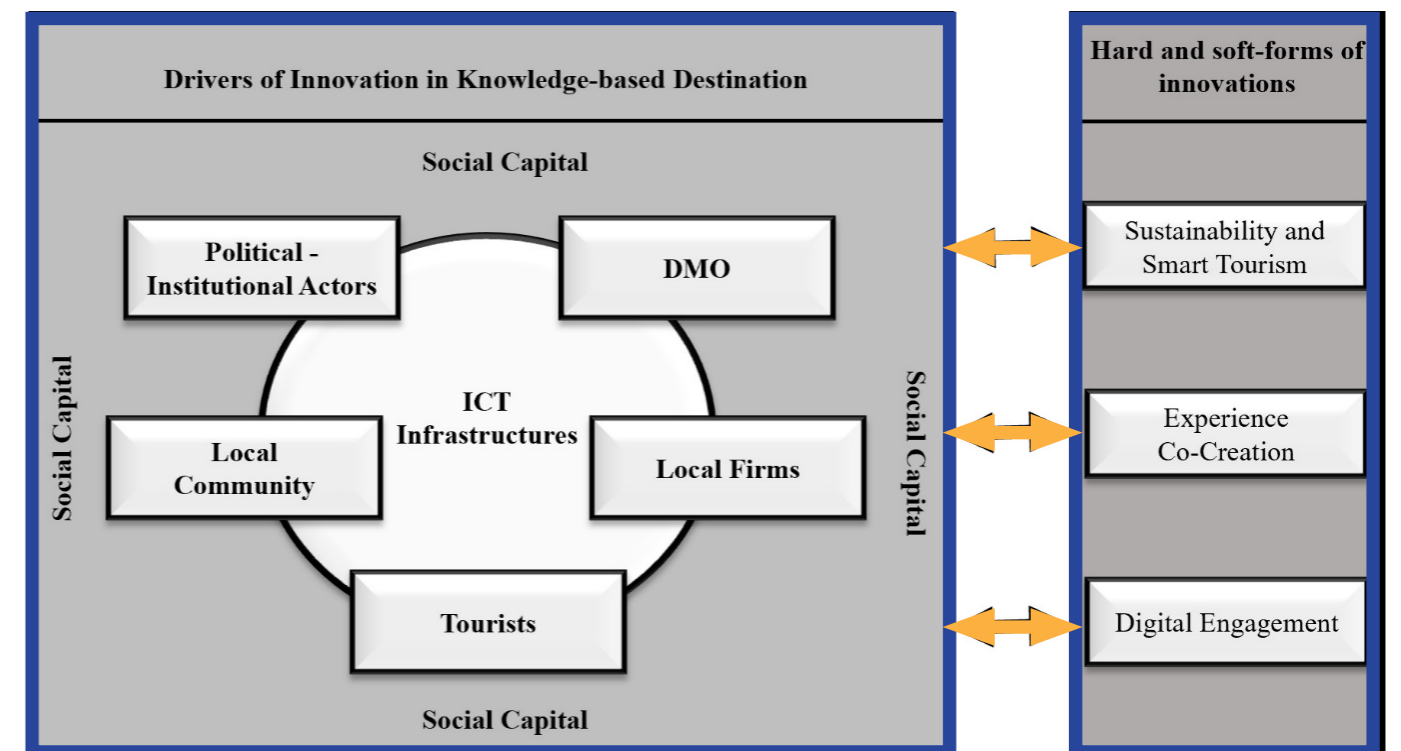
Source: Adapted by Trunfio and Campana (2019)

Oppositely, technology-driven innovation leverages on extensive use of ICTs, fundamental infrastructures to access and reduce uncertain and unpredictable environments based on high flows of intensive knowledge, re-engineering personal and trust destination actors' relationships (Roper & Love, 2018; Trunfio et al., 2012; Trunfio & Campana, 2019, 2020).

1. Technology-driven Innovation in Tourism Destinations

Technology-driven innovation enriches destinations with new value propositions and pushes forward the definition of new sustainable development business models (Trunfio & Campana, 2019, 2020; Trunfio & Pasquinelli, 2021). It empowers the combination of smartness and sustainability and stimulate actors to anticipate, identify, and manage imbalances that could afflict the destination development negatively (Buhalis & Amaranggana, 2013; Del Chiappa & Baggio, 2015; Femenia-Serra et al., 2019a; Gretzel et al., 2015; Ivars-Baidal et al., 2019; Pasquinelli & Trunfio, 2020a, 2020b; Trunfio & Campana, 2019, 2020).

Technologies enhance stakeholder participation and engagement in destination management and development (Ammirato et al., 2018; Go & Trunfio, 2011; Stankov & Filimonau, 2019; Trunfio et al., 2012; Trunfio & Campana, 2020). Besides, technology-driven innovation leverages on online and offline ICTs to involve destination actors, including tourists, in innovative practices of human-to-technology interaction based on co-personalisation, co-gamification, co-service, and co-production (Buhalis & Sinarta, 2019; Buonincontri & Micera, 2016; Femenia-Serra et al., 2019a; Neuhofer et al., 2012), enabling advanced forms of experience co-creation and destination value co-creation (Trunfio & Della Lucia, 2019).

2. ICT-based tools in destination management

2. ICT-based tools in destination management

ICTs drive the transformative technological paradigm of tourism destinations management moving from 'web-based technologies' (Buhalis, 1998) to 'disruptive technologies' (Aarstad et al., 2015; Buhalis, 2019; Buhalis et al., 2019; Buhalis & Sinarta, 2019; Marasco et al., 2018; Trunfio & Campana, 2019, 2020). They have removed the barriers of destination actors' communication and collaboration, facilitating knowledge sharing and dissemination and innovating destination products and services (Femenia-Serra et al., 2019a; Marasco et al., 2018; Munar, 2012; Neuhofer et al., 2012; Racherla et al., 2008; Stamboulis & Skayannis, 2003; Trunfio & Campana, 2019, 2020; Trunfio & Della Lucia, 2019).

ICTs are an umbrella of different tools and infrastructures (Table 1) with varying usability levels that aim to satisfy actors' needs both at inter- and intra-sector levels in tourism destinations (Ali & Frew, 2014a, 2014b). They support destination actors in decision-making processes (Ali & Frew, 2014a, 2014b; Femenia-Serra et al., 2019a; Trunfio & Della Lucia, 2017) and facilitate access to external information sources, attracting and involving creative and intellectual talents or tourists, transforming destinations into a dynamic e-learning experience system (Binder, 2018; Mengi et al., 2017; Pique et al., 2019; Trunfio & Campana, 2020). Leveraging on artificial intelligence and big data analysis, ICTs improve environmental management, anticipating, managing, or avoiding urban/social imbalances (Ammirato et al., 2018; Ivars-Baidal et al., 2019; Pasquinelli & Trunfio, 2020b). ICTs can integrate conventional mobile devices with spatial-location sensors and immersive information. They store and/or profile destination actors and environmental information to address smart practices of sustainable destination growth (Ali & Frew, 2014a, 2014b; Ammirato et al., 2018; Femenia-Serra et al., 2019b; Pasquinelli & Trunfio, 2020b; Trunfio & Campana, 2020). Moreover, they are innovative drivers to promote smart practices of destination attractions valorisation and preservation (Ali & Frew, 2014a; Bec et al., 2021; Marasco, Buonincontri, et al., 2018).

Table 1. ICT-based tools

Types of ICT-based tools	Definition
Community informatics	Community participation platforms to support actors' decision making and engagement in the destination. These platforms summarise all available information generated by online electronic media.
Tourism information system	Digital warehouse of destination information to support and assist actors' decision-making.
Location-based services	Technology sensors installed in the destination to acquire actors' information generated by mobile tools (e.g., smartphones). They provide information on the surrounding environmental context, personalising and influencing tourists' choices during the destination visit.
Virtual tourism	Web services tools (e.g., virtual reality, augmented reality, mixed reality) for immersive access to destination information about hotels, restaurants, tourist attractions, etc. They provide alternative access to the destination, reducing the overcrowding of a tourist site/attraction.
Environment management information systems	Hardware, software and mobile computing tools collect environmental information to support destination managers' decision-making processes.
Destination management systems	DMOs' planning tools used for information management, marketing, stakeholders' partnerships and information exchange, resource management, distribution, tourists' education and satisfaction, and destination sustainable development.
Geographical information systems (GPS)	Information systems to capture, manipulate and store spatial-position information of different actors in the destination.
Intelligent transport system	Telematic tools store detailed information on the destination transport system, providing estimation models on the destination traffic congestion.
Carbon calculator tools	Information systems to monitor CO_2 emission and clean energy in destination, supporting the definition of new sustainable policy by destination managers.
Global positioning system	Satellite-based navigation systems for the tracking of tourists' smartphones, providing information on their location and navigation for managerial purposes (e.g., marketing segmentation, attraction congestion).
Computer simulation tools	Mathematical algorithms to forecast the impact of economic, natural or socio-cultural influences in the destination.
Economic impact analysis software	Institutional information systems to forecast the public spending and financial budget in the destination development.
Weather, climate and ocean change forecasting software	Forecasting tools of future or catastrophic events in the destination: weather, climate and ocean phenomenon.

Source: Adapted by Ali and Frew (2014a, 2014b).

ICTs' use in tourism destination requires investments in the gradual process of technology acceptance and adoption (Ali & Frew, 2014a, 2014b; Lee, 2015; Trunfio & Campana, 2020). Tourism destinations that experience fast technology changes and neglect problems of information overload, technostress etc., can generate a stagnation state (Montaño & Ivanova, 2016), reducing actors' participation in knowledge sharing and dissemination (Trunfio & Campana, 2020).

3. Digital engagement in tourism destination

Literature considered the ICTs infrastructures as able to stimulate and enhance actors' collaboration in destination networks and stakeholder engagement, supported by alternative forms of bottom-up and top-down legitimation and power (Ammirato et al., 2018; Baggio & Cooper, 2010; Go & Trunfio, 2011; Martínez-Pérez et al., 2019; Sigala, 2018; Stankov & Filimonau, 2019; Tuli et al., 2019; Trunfio & Campana, 2020). They offer both online participatory decision-making and forms of e-democracy (Cabiddu et al., 2013; Hays et al., 2013; Melis et al., 2015; Munar, 2012; Rihova et al., 2015; Sigala & Marinidis, 2012; Trunfio & Della Lucia, 2019). Social media and other digital tools redefine how tourists, residents and other stakeholders openly interact. They allow tourists to comment, recommend, write reviews, create and share contents across online networks anytime and anywhere, providing them direct access to destinations and tourism organisations. Through social media and other digital tools, Destinations Management Organizations (DMOs) can interact directly with tourists, residents and other stakeholders through different social platforms, design dynamic visit experiences, and build destination strategies and brand reputation (Munar, 2012; Hays et al., 2013). Capitalising on digital platforms to enhance stakeholder interaction and engagement and integrating multiple knowledge, DMOs can also drive forms of participative destination innovation (Trunfio & Campana, 2020; Trunfio & Della Lucia, 2019).

3.1 Digital stakeholder engagement: the external perspective

Although customer and tourist engagement research has been increasing, its definition remains multidimensional, multidisciplinary and polysemic (Brodie et al., 2011; Hollebeek et al., 2016, 2019; Kumar et al., 2019; Vivek et al., 2012). Drawing on diverse theoretical backgrounds, particularly service-dominant logic and relationship marketing, several customer and tourist engagement conceptualisations have been proposed in literature from different perspectives: psychological, behavioural or value-based (Bowden, 2009; Brodie et al., 2011; Kumar et al., 2019; Vivek et al. 2012). Literature generally understands customer\tourist engagement as a highly experiential, subjective, and context-dependent construct (Brodie et al., 2011) based on customer-brand interactions (Hollebeek, 2018) that encompasses cognitive, emotional, and behavioural dimensions due to its multidimensional nature (Brodie et al., 2013; Hollebeek et al., 2016; So et al., 2016; Vivek et al., 2012).
Antecedents and consequences of customer\tourist engagement have been also investigated (Bowden, 2009; Bryce et al., 2015; Leckie et al., 2016; So et al., 2016). Various factors, such as trust, commitment, customer

value, customer equity, satisfaction, and loyalty, have been identified and investigated as consequences of consumer engagement (So et al., 2016). According to the literature, engaged tourists demonstrate deep commitment and connection with brand\destination, which can enhance the customer\tourist feelings and behaviours (Hollebeek et al., 2016; So et al., 2016). Therefore, engaged tourists are expected to be more interested to re-visit and more loyal towards the destination (Bowden, 2009; Bryce et al., 2015).
The advent of digital platforms, especially social media, led to an explosion of interest in customer\tourist engagement in the online context with a focus on the behavioural dimension of this complex construct (Barger et al., 2016; Oviedo-García et al., 2014; Peltier et al., 2020; Schivinski et al., 2016). Browsing and consuming user-generated contents, active participation in online tourist communities, content creation, blogging and reviewing are just some of the customer\tourist engagement behaviours considered in the literature (Cabiddu et al., 2014). Understanding, monitoring, and measuring engagement are also key aspects, interesting scholars and destination managers who have been adopted several indicators and KPIs of the destination brand performance (Mariani et al., 2018; Oviedo-García et al., 2014; Trunfio & Della Lucia, 2019).

3.2 Digital stakeholder engagement: the internal perspective

If engaging tourists can be relatively easy, involving other stakeholders such as residents, organisations, and firms in developing competitive destinations remains a considerable challenge for DMOs (Trunfio & Della Lucia, 2019). Tourism studies have long recognised the importance of the engagement of complex networks of stakeholders in the decision-making process and in different activities as critical for creating sustainable tourism development and increasing destinations' social legitimacy and reputation (Cabiddu et al., 2013; Hays et al., 2013; Munar, 2012; Sigala & Marinidis, 2012; Trunfio & Della Lucia, 2019). To do that is important to design an effective stakeholder engagement strategy based on identifying and balancing the special interests involved, incorporating stakeholders' input, and using effective communication techniques.
Engaging stakeholders in tourism planning and development can take many forms and can include information dissemination, public meetings, formal or informal invitations to submit written comments, workshops, large group planning processes, training and technical assistance, task forces, surveys, focus groups etc. (Chase et al., 2012). The digital revolution provided new tools and platforms to support and manage destination stakeholder engagement strategies, leading to forms of e-democracy (Sigala & Marinidis, ▷

2012). In e-democracy ICTs are exploited to empower people to actively participate in bottom-up decision-making processes, to (collaboratively) make informed decisions, and to develop social and political responsibility for both the formulation and implementation of public policies. Forms of e-democracy can range from weak/passive (e.g., e-information and consultation) to strong/active (e.g., e-participation and e-voting) depending on the level of stakeholders participation in the decision-making process (Sigala & Marinidis, 2012).

Through reticular interactions, collaborative relationships and knowledge sharing, digital tools also allow tourists and other stakeholders to act as partners and co-creators of value. They contribute to generating contents, creating dynamic visit experiences not manipulated by DMOs, and building destination strategies and brand reputation (Trunfio & Della Lucia, 2019), enhancing destination value co-creation (Cabiddu et al., 2013).

4. Tourism experience design

The tourism experience is one of the leading topics in tourism research. Cross-fertilising diverse disciplines, tourism experiences progressively evolve towards more complex interpretations (Tuomi et al., 2020). Tourist experience has been considered a complex phenomenon that provides an analysis of the sensory, emotional, cognitive and behavioural responses of the tourist (Pine & Gilmore, 1999). The planned components and the relationship process are activated in the three phases of the tourist journey (pre, during and post-experience) (Lemon & Verhoef, 2016).

The complexity of the tourist experience has been determined by several authors (Volo, 2009; Cole and Scott, 2004; Uriely, 2005) and involves difficulties in: defining it, identifying and measuring its components, and understanding how it changes according to the characteristics of tourists. For example, the market's dynamism can mutate the character of some tourism activities and open a whole new set of experiences (e.g. virtual tours). Lash and Urry (1994) indeed extended the status of tourist to many different situations, whether consumers were enjoying attractions at the destinations or in a virtual reality setting, even before the on-site destination. Coherently, to define tourist experience we can use the more general customer experience definition considered as the evolvement of a person's sensorial, affective, cognitive, relational, and behavioural response to certain stimuli (e.g. scenario, ambient, people, digital website) along the pre-purchase, purchase and post-purchase situations (Pine & Gilmore, 1999; Lemon & Verhoef, 2016; Homburg, Jozic & Kuehnl, 2017).

Considering the complexity of the tourism experience co-creation (Prebensen & Foss, 2011), which involves diverse actors, including tourists, significant challenges emerged in framing the role of ICTs and its impact on the human-technology interaction (Femenia-Serra & Neuhofer, 2018; Neuhofer et al., 2012; Trunfio & Campana, 2020). Levering on the combination of offline and online tools, DMOs can enhance value in digital network interactions and participatory decision-making, enabling forms of experience co-creation and destination value co-creation (Trunfio & Della Lucia, 2019). So, experiences are not self-generated but induced by destinations or tourist firms (Ferraresi & Schmitt, 2018), through creative marketing, events, and especially digital tools and ICTs platforms.

ICTs platforms caused radical changes redefining physical and virtual experience co-creation spaces in the pre, during and post-travel phases (Neuhofer et al., 2012). A technology-enhanced destination experiences model framed two co-creation levels (physical and virtual co-creation), involving diverse destination stakeholders in multiple levels of engagement (Neuhofer et al., 2012). Stakeholders' active physical and digital participation ▷

in the experience journey (before, during and after consumption) produces an experiential value in use (Ranjan & Read, 2014).

Levering on ICTs, destinations have access to external knowledge based on the attraction and involvement of creative and intellectual talents and tourists, transforming destinations into a dynamic system of experience co-creation, co-gamification, and co-personalisation (Buonincontri & Micera, 2016; Femenia-Serra et al., 2019; Neuhofer et al., 2012; Trunfio & Campana, 2019). Building on the experience economy theoretical framework, which combines learning, education, and entertainment with aesthetic and escapist experiences (Pine & Gilmore, 1999), literature framed multiple typologies of emotional and immersive experiences. ICTs innovation plays a significant role in innovating and enhancing immersive experiences, such as: education, heritage valorisation, socialisation, escape, and entertainment (Trunfio et al., 2020). Virtual reality (VR) defined as a computer-generated 3D environment that stimulates full immersion in a specific digital experience (Wei, 2019; Pizzi et al., 2019; Guttentag, 2010) is one of the leading technologies used to attract and engage tourists thanks to its magnitude to simulates real situations in a virtual environment (Diemer et al., 2015) and in an immersive way. Several authors (Ijsselsteijn & Riva, 2003; Desai et al., 2014; Wei, 2019) have emphasised the role of VR in the creation of symbolic experiences generated simply using a VR viewer or in the form of online virtual tours. VR can transmit the experience of escapism to users. That is, VR not only enables users to escape from their everyday life but also stimulates their senses and provides opportunities for virtual interaction (Guttentag, 2010). Notably, a multi-sensory experience provides for complete absorption, thereby increasing the delight and the value perceived in the stimulus (e.g., a museum tour or shopping at an up-market store'). From a marketing perspective, VR can allow for a 'try before you buy' experience (Han et al., 2019; tom Dieck et al., 2018) and can have significant implications in terms of behavioural intentions. For example, a customer who can experience a hotel in a dynamic 3D virtual tour (instead of seeing merely static pictures) will be more willing to book a room. Because of such features, VR has been widely implemented and investigated within tourism and hospitality. Overcoming people' inherent distance from the products or services offered within the context of tourism, VR is an opportunity to enlarge the target audience. Recently, several destinations are using virtual tour to enhance awareness around a place or a specific element of the destination (e.g., museum) by creating virtual spaces where people can anticipate the on-site experience meeting local community and sites. This opportunity particularly helps destinations and tourism firms in these challenging times of pandemic crisis by stimulating the desire to travel and visit destination.

5. Sustainability and destination management

Sustainable tourism has received increasing attention amongst scholars, policymakers, and media and raising awareness of local impacts and pitfalls of tourism growth. Tourism policies and destination management approaches must consider the connections among tourism industry actors and dynamics, local communities, and the socio-cultural and natural environment, facing the difficulty to turn the sustainability principles into practice effectively (Buckley, 2012; Liu, 2003; Lu & Nepal, 2009; Ruhanen, Weiler, Moyle, & McLennan, 2015).

The sustainable tourism agenda is all but free from unresolved contradictions. The "rhetoric of balance" between the economic, social, and environmental dimensions is hard to be put in place in practice (Hunter, 1997; Garrod & Fyall, 1998; Liu, 2003) and the on-going pandemic crisis further fuels concerns about the real opportunity to pursue such balance in the post-covid scenarios. To be realistic, we cannot forget the hard and, in some case, unlikely composition of local stakeholders' conflicting interests, undermining sustainable development trajectories in concrete (Dwyer, 2018). A practice-oriented interpretation of the sustainability goals introduced responsible tourism as subjective responsibility of tourism stakeholders (Bramwell et al., 2008; Goodwin, 2019; Burrai et al., 2019). Sustainability marketing is discussed in tourism studies and practices to foster behavioural change (Font & McCabe, 2017), particularly at nurturing a responsible travelling culture, at educating travelers towards respecting hosting local communities and the destination natural and built heritage (Pasquinelli & Trunfio, 2020a). Indeed, there is room for further empirical inquiry in the current pandemic crisis, when much debate on the need and opportunity to respond to the crisis with sustainability practices in tourism has emerged. However, now, this remains a statement if we look at the national and local policies so far put in place for tourism recovery (Collins-Kreiner & Ram, 2020). The sustainable tourism debate has recently catalysed attention to the overtourism phenomenon, signaling the negative tourism impacts, mainly in urban contexts (Pasquinelli & Trunfio, 2020a), although affecting non-urban destinations too (Peeters et al., 2018; Milano, Novelli & Cheer, 2019). The key characteristics of this phenomenon were said to be: deterioration of residents' quality of life and tourist experience value (Cheer, Milano & Novelli, 2019; Dodds & Butler, 2019; Novy & Colomb, 2019); dramatic change in economic, physical and social city landscapes (Peeters et al., 2018; Koens, Postma, & Papp, 2018); urban museumification and Disneyfication (Gravari-Barbas & Guinand, 2017); tourism-phobia and anti-tourism (Colomb & Novy, 2016; Milano, 2017; Martìn Martìn et al., 2018). Overtourism stresses crucial aspects that destination managers

can no longer neglect, given the global mobilisation of public opinion on this matter and the conflicts (including violent conflicts) exacerbated by this phenomenon in several European cities, such as Barcelona and Berlin which became the overtourism symbols. Even when overcrowding is suspended by global mobility restrictions related to the pandemic, it is evident how destination managers have to address several issues raised by the sustainable tourism and overtourism debate. Sizing tourism pressure, balancing tourism activities, and, thus, boosting sustainability remain key challenges and are also likely to become preconditions for destination competitiveness in the upcoming tourism market.

5.1. Regulating, managing and marketing the sustainable destination

Practices of sustainability emerged in several destinations. A classification of distinct yet potentially coexisting approaches addressing overtourism imbalances and boosting sustainable destinations are regulation, management, and marketing (Pasquinelli & Trunfio, 2020b).

The regulation approach is defined as deploying political-institutional power to impose rules and norms which aim to establish a sustainable destination. Tourist taxes, hospitality and commercial activities licensing, limited access to tourist hotspots, and control over the tourism system are examples of the regulative approach. The management approach, instead, puts in place processes of facilitation and steering of stakeholder networks, giving direction to the destination development, without imposing any given norm or rule on how certain activities should be carry out. Without impositions or limitations, the managerial approaches can frame destination products and experiences that anticipate the market and orient the demand in a direction that is compatible with sustainable tourism. The marketing approach must be understood within the destination management framework, emphasising a market-orientation based on the analysis and understanding of the market-leading the construction of the tourism product and processes of value co-creation. Sustainability marketing (Font & McCabe, 2015), including demarketing actions, is meant to promote responsible attitude amongst visitors and residents, but it also aims at co-creating the value of sustainable experiences of the destination. However, the impacts of these approaches in terms of sustainability are far from being sized and measured. Instead, there is significant need for research on type and magnitude of the concrete effects these sustainability approaches may produce, also assessing their capacity to conservatively maintain the status quo of a continuous tourism growth (beyond the pandemic mobility constraints) by mitigating the negative impacts or transforming tourism dynamics and the destinations (Milano et al., 2019; Cheung & Li, 2019; Higgins-Desbiolles et al., 2019; Cheer et al., 2019).

5.2. Integrating smartness and sustainability

The relation between sustainability and smartness has been discussed and problematised. It finds its composition in the city dimension, going well beyond the tourism precinct borders. A variety of research streams contributed to the "sustainable city" debate: the "digital city", the "information city" and the "smart city" labelled the insights into the technological driver in urban development, which has been rapidly growing in popularity (de Jong et al., 2015).

The smart tourism destination (STD) is the conceptualisation that, emerged in tourism studies, combines sustainability and smart city framework, and it can be considered part of the evolutionary concept of the smart city (Errichiello & Micera, 2017; Camero & Alba, 2019; Cavalheiro et al., 2020). The sustainable tourism debate recently proposed integration between the sustainable destination and the smart destination concepts through two frameworks, focusing on urban issues regarding mobility, housing, provision of services, social segregation and the environmental footprint to tourism development. The Smart City Hospitality Framework (Koens et al., 2019) introduces a way to address overtourism by pursuing a sustainability transition in the destination, creating opportunities for improving the quality of life and enhancing sustainable urban development. It proposed a destination design-driven approach to governing tourism in the city, by merging sustainable development and the city hospitality dimensions. City hospitality, understood as livability, experience quality, smart hospitality, sustainability, and equitability (from natural, social and economic perspectives), and resilience (as an ability of the urban systems to adapt to structural change), are all gears of the smart city mechanisms guaranteeing urban sustainability (Koens et al., 2019).

The Smart-City Lens (Pasquinelli & Trunfio, 2020b) frames sustainable development in knowledge-based destinations and is composed of three key elements: internal and external actors (including tourists), ICTs platforms and social capital. These are at the core of those mechanisms facilitating inclusive forms of sustainable tourism development, thus overcoming the limitations of the technology-led approaches that seek technical efficiency and effectiveness (Trunfio & Campana, 2019). This framework tries to reconcile bottom-up engagement in sustainable development with a top-down institutional dimension (Pasquinelli & Trunfio, 2020b). Building on the Smart City Hospitality Framework, the Smart-City Lens model reinterprets city hospitality, sustainability and resilience as meta-effects enhancing economic recovery and equitability, driving quality of life and raising the value of the tourism experience.

5.3. Smart technologies for sustainability

The international debate discussed and recommended adopting diverse smart technology tools to support sustainable development (Ali & Frew, 2014) and promote sustainable destinations (UNWTO, 2018). Nevertheless, an integrative and holistic understanding of their potential in the smart and sustainable city framework is lacking.

The recent debate on overtourism has considered smart technologies to a limited extent (Zubiaga et al., 2019; Ivars-Baidal et al., 2019; Garcìa-Hernandez et al., 2019; Trunfio & Pasquinelli, 2021). Smart tools are often adopted in an occasional way and with a limited scope (Ivars-Baidal et al., 2019) and often remain incapable of making a difference in pushing the destination on a sustainable development route (Garcìa-Hernandez et al., 2019, p. 29).

Part of the actions addressing overtourism are based on smart technologies, especially those underlying managerial and marketing approaches, but there is room to sustain ICT tools that can also fruitfully integrate and enhance more traditional actions (Trunfio & Pasquinelli, 2021). Table 2 provides examples of smart tech based and traditional tools that, responding to different approaches, are considered in relation to their ICT content and potential evolution. Big data collection and analysis, enabled by the smart technology tools, significantly support management and marketing actions (Gajdošík, 2019), but they can also be a real-time support for flexible and adaptive regulative actions. Differently, such potential remains largely untapped. Smart tech for limiting access can, for instance, contribute to real-time redirection of tourist flows, or it can support the definition and respect of limitations against the uncontrolled spread of hospitality business and non-professional, short-term rentals.

Beyond the use of mobile apps to target travelers and the sophisticated use of social media to create preferences and induce sustainable behaviors, mobile systems provide the opportunity to monitor and make evidence-based decisions, not only for medium/long-term planning and destination management, but also for real-time reactions to critical circumstances. In sum, smart tech-based actions contribute to a) dispersing tourist flows and shaping tourists' behaviors; b) planning, managing, and marketing the destination; c) integrating tourism in a broader vision of development; and d) engaging with visitors.

Table 2. Smart tech-based and traditional actions

Rationale of actions	Smart tech-based actions	Traditional actions
Regulation		Compensation for tourists' impacts
		Limiting the spread of hospitality business
		Avoid tourism-related commercial conversion
		Support commercial life of city centers
		Redirect tourist flows
Management	Planning mitigation actions (Forecasting techniques; Travelling mobile tracking systems)	Development of new travel products
	Integrated destination management (mobility, housing, public space management...) through ICT platforms	
	Stakeholder engagement and promotion of tourists' education	
Marketing	Targeting specific segments of the tourism market (travelers' mobile tracking systems to analyse behaviours and big data analysis for targeting)	
	Managing access (Smart ticketing /dynamic pricing- discounts)	
	Marketing the brand of responsible tourism/ de-marketing (Critical use of social media to share "different" expectations and diversify the destination experiences)	
	Engaging with city visitors (Mobile gaming app)	
Weather, climate and ocean change forecasting software	Forecasting tools of future or catastrophic events in the destination: weather, climate and ocean phenomenon.	

Source: Trunfio & Pasquinelli, 2021

5. Sustainability and destination management

Beyond the focus on tourists and tourism organisations (public and private), smart tools for sustainability may succeed in engaging residents, workers, entrepreneurs indirectly involved in the tourism sector in a more integrative way, as suggested by the Smart City Hospitality Framework and Smart City Lens, working as key enablers of these theoretical models. On the other side, smart tools can not only be envisioned as support to centralised destination decision-making and planning, but they can also be the result of grassroots actions involving a wide range of stakeholders (belonging to the tourism market or to the wider local community) that responsibly engage with practices of sustainability, preventing and addressing the tourism impacts.

6. Metodology

6. Methodology

An exploratory empirical study surveyed smart technology tools adopted within Italian and international destinations, where DMOs invested in ICT tools, to trigger innovative and more sustainable paths of development. The practice-led research approach proposed in this study moves from the need to highlight the various functions played by technologies for the destination, which are usually treated in literature by distinct theoretical domains. These functions regard the digital engagement, smart experiences, and sustainability. The integration of these diverse theoretical constructs has never been explored in previous studies (Baxter and Jack, 2008; Creswell, 2007; Eisenhardt, 1989; Eisenhardt et al., 2016; Xiao & Smith, 2006; Yin, 2014) and this research wants to make a first preliminary step in the direction of filling this gap.

An original dataset was built through a worldwide mapping of ICT tools. Data collection employed secondary sources (i.e., online documents, online reports, online magazines, and website information), and 60 ICT tools were extracted from September to December 2020 from web search. The criterion for inclusion of tools in the dataset was the relevance of the tools for the destination as a system (tools adopted for the single site/attractor were discarded), with the DMO owning the tool. Six researchers came together in an interactive discussion group to screen the preliminary 60 ICT tools and remove all those not closely fitting the research scope, safeguarding the research quality and effectiveness (Nyumba et al., 2018). Each tool was described and coded according to: a) Ali and Frew's (2014a, 2014b) macro-categories of ICT tools for sustainability; b) the scale of implementation (i.e., city, metropolitan area, region or country level); c) involvement of four destination actors (i.e., internal actors such as firms and local communities, and external actors such as tourists); d) phases of the destination experience in which the tool plays a role (i.e., pre-visit, during the visit, post-visit); and, e) sustainable development approaches to actions (i.e., regulative, marketing and management).

The sections below present a description of the set of tools and a cross-case analysis highlighting patters of technology usage across the sampled cases.

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7. Findings

Fifty-seven ICT tools were included in the dataset, 42 were adopted in international destinations and 15 in Italian destinations, to drive technology-driven innovation, enhancing stakeholder digital engagement, smart experience, and sustainable development. ICT investments in smart tools, infrastructures, and platforms activated by international and Italian DMOs are meant to play a vital role in enhancing stakeholders' socio-economic relationships and reengineering destination management decisions. In fact, ICTs are supposed to enable knowledge sharing and dissemination that improve destination value, drive new forms of sustainable development based on high levels of liveability, quality of tourism experience, equitability, and resilience (Koens et al., 2018; Pasquinelli & Trunfio, 2020a).

7.1 Technology-driven innovation in international destinations

International destinations adopted diverse ICTs tool (Ali & Frew, 2014b, 2014a) to reinforce digital engagement and facilitate both smart experiences and sustainable tourism. Table 3 summarises the characteristics of each technological tool: tool name and owner; Ali and Frew's (2014b, 2014a) macro-category of ICT tools for sustainability; the scale of implementation (destination level); sustainable development approaches to actions (Pasquinelli & Trunfio, 2020b); destination actors' involvement; phases of the destination experience in which the tool plays a role (pre, during and post). International DMOs adopted diverse smart technology tools to nurture technology-driven innovation (Figure 2 and Table 3), highlighting the relevance of combining digital stakeholders' engagement and smart experiences to introduce new smart business models of sustainable development (Buhalis & Amaranggana, 2013; Femenia-Serra et al., 2019; Trunfio & Campana, 2020; Trunfio & Pasquinelli, 2021).

Figure 2. The adoption of ICTs based tools in international destinations
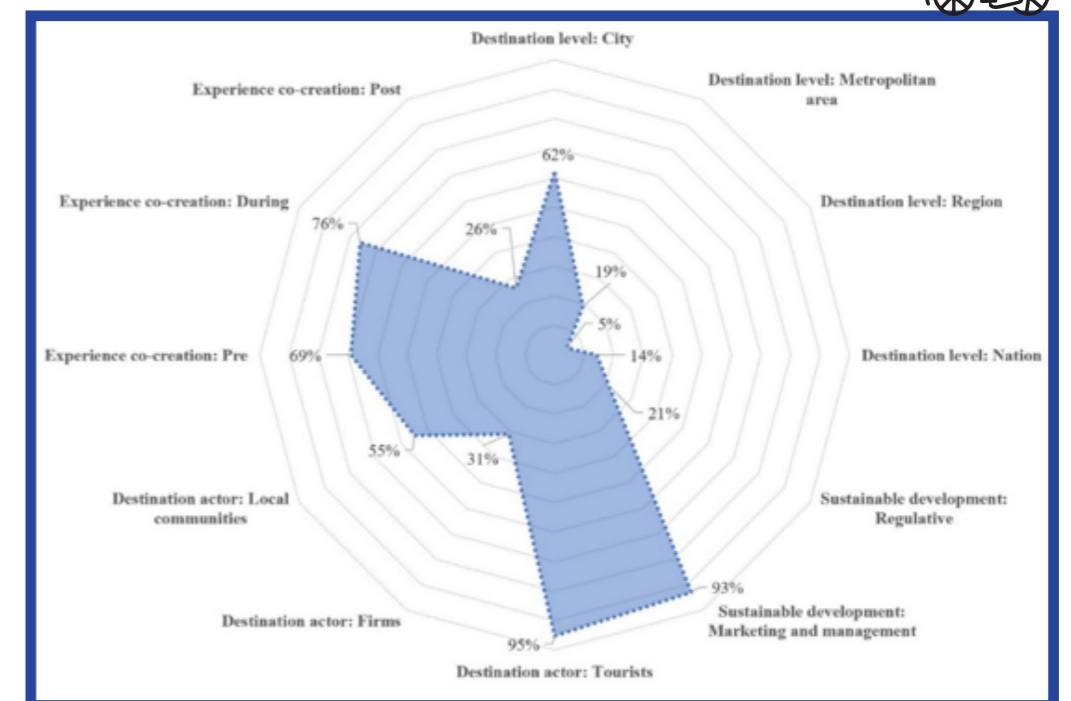
The urban (62%) and metropolitan area (19%) are the main contexts in which DMOs adopted the sampled digital tools. Destination sustainable development represents the prevailing purpose of the smart tools introduced before and during the pandemic crisis worldwide.
93% of sampled international destinations adopted various digital tools to support destination sustainable managerial and marketing actions; only 21% of the tools are deployed to implement regulative actions.

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Table 3. ICT-tools in international destinations

Table 3. ICT-tools in international destinations

Tools	Owner	Ali and Frew's (2014a, 2014b) ICT-based tools	Destination level				Sustainable development		Destination actors			Experience co-creation		
			City	Metropolitan area	Region	Nation	Regulative	Marketing and management	Tourists	Firms	Local communiti	Pre	During	Post
Table Rock State Park VR	South Carolina State Park Service	Virtual tourism		Table Rock State Park, South Carolina (US)			X	X	X			X		
Pokemon go	Niantic – Nintendo and Visit Orlando	Virtual tourism	Orlando					X	X	X		X	X	X	X
Pokemon go	Niantic – Nintendo and Visit Anaheim	Virtual tourism	Anaheim					X	X	X		X	X	X	X
Pokemon go	Niantic – Nintendo and Visit Portland	Virtual tourism	Portland					X	X	X		X	X	X	X
Pokemon go	Niantic – Nintendo and Visit Fukushima	Virtual tourism	Fukushima					X	X	X		X	X	X	X
Pokemon go	Niantic – Nintendo and Visit Thailand	Virtual tourism				Thailand	X	X	X		X	X	X	X
Discover Moscow app	Moscow city	Virtual tourism	Moscow				X	X	X				X	
Virtual Singapore	Singapore Government	Virtual tourism				Singapore	X	X	X	X	X	X	X	X
Japan VR	Japan DMO	Virtual tourism				Japan		X	X			X		
Buzzin app	Sparta Digital	Virtual tourism	Manchester					X	X		X		X	
Faroe Islands Remote Tourism	Visit Faroe Islands	Virtual tourism			Faroe Islands		X	X		X	X			
Virtual Helsinki	Visit MyHelsinki	Virtual tourism		Helsinki			X	X			X	X	X	
Stadtgeist Karlsruhe app	Karlsruhe DMO	Virtual tourism	Karlsruhe				X	X				X		
Play London with Mr Bean app	Visit London (London & Partners)	Location-based system	London					X	X	X	X	X	X	X
StreetMuseum app	London Museum	Location-based system	London					X	X			X		
Shakespeare a Stratford-upon-Avon app	The Shakespeare blog	Location-based system	Stratford				X	X				X		
MinStad	Gothenburg city	Location-based system	Gothenburg				X	X		X				
Rock Sensors	Vilnius city	Location-based system	Vilnius				X	X			X			
Stockholm Sounds	Stockholm Business Region + Spotify	Location-based system	Stockholm				X	X			X			
TravelPlot Porto app	Visit Portugal	Location-based system	Porto				X	X	X		X			
Sheep View 360	Visit Faroe Islands	Location-based system			Faroe Islands		X	X		X	X			
Blind Walls Gallery Breda	Blind Walls Museum	Location-based system	Breda				X	X		X	X	X		
Nice Greeters	Nice Tourism	Community informatics	Nice				X	X		X	X			
WeChat Helsinki	Visit MyHelsinki	Community informatics		Helsinki			X	X	X	X	X	X	X	X
MDDTY	Visit Brussels	Community informatics	Brussels				X	X	X		X	X		
I Amsterdam letters	Visit Amsterdam	Community informatics	Amsterdam				X	X	X		X	X	X	X
NEXTO storytelling app	Nexto	Community informatics		Helsinki			X	X		X	X			
MyHelsinki	Visit MyHelsinki	Community informatics	Ljubljana				X	X		X	X	X	X	
smartakartan.se Smart Map	Gothenburg city: Sharing Cities Sweden	Community informatics		Goteborg, Malmo, and Karlstad			X	X	X	X	X	X	X	X
Victoria de malaguena chatbot	Segittur	Tourism information system	Malaga				X	X		X	X	X	X	
Looks like you Need Iceland #Letitout	Visit Iceland	Tourism information system			Iceland		X	X		X	X	X		
Where is Vilnius	Go Vilnius	Tourism information system	Vilnius				X	X			X	X		
MyVizito Côte d'Azur app	Nice Tourism	Tourism information system	Nice				X	X				X		
Aruba Health app	Aruba Government – Department of Public Health	Tourism information system		Aruba island			X	X			X		X	
Smart Costa del Sol	Costa del Sol – Malaga Blog	Tourism information system		Malaga and Costa del Sol			X	X	X	X	X	X	X	X
OnlyLyon Experience	OnlyLyon DMO	Destination management system	Lyon				X	X	X					
Dubrovnick – Respect the City (Smart City Action Plan)	Dubrovnick city	Destination management system	Dubrovnick				X	X	X	X	X	X	X	
Tourist city cards	Prague city	Intelligent transport system	Prague				X	X				X	X	
Tourist city cards	Amsterdam city	Intelligent transport system	Amsterdam				X	X	X	X		X	X	
Tourism Tracer – Tourism Tracking Technology	University of Tasmania	Economic impact analysis software			Tasmania		X	X					X	
Web-based advanced reservation system	Hawaii Tourism Authority	Environment management information systems	Nahena and Na Pali Coast, Hawaii State Parks				X	X	X		X			
No Need to Fly	Deutsche Bahn	Not classified				Germany	X	X	X		X	X		
Total			26	8	2	6	9	39	40	13	23	29	32	11
%			62%	19%	5%	14%	21%	93%	95%	31%	55%	69%	76%	26%

Innovative ICT applications aim to redirect flows, reduce overcrowding, introduce new thematic products, and stimulate changes in tourist behaviours (Pasquinelli & Trunfio, 2020b).

Digital stakeholder engagement represents a key driver of the destination sustainable development, as consolidated literature affirmed, stressing the importance to include a diverse set of stakeholders (Cabiddu et al., 2013; Hays et al., 2013; Sigala & Marinidis, 2012; Trunfio & Della Lucia, 2019). The sample shows that ICT tools have been mainly launched to engage tourists (95%) in valuable experiences and with sustainability concerns for them to be more aware of them. Capitalising on the technology power, diverse tools integrate the external perspective with the one of local communities (55%) and directly involve local firms (31%), creating virtual spaces where the value of meeting local community and co-creating experiences can be pursued. Technology involves diverse destination stakeholders in multiple levels of engagement, which integrate physical and digital spaces during the experience in most cases (76%), as consolidated literature affirmed (Neuhofer et al., 2012; Ranjan & Read, 2014). Adopting new technologies to build virtual pre-experience (69%) represents another leading aspect emerging from the analysis. Virtual experience may create desire to visit destination or substitute the physical experience in the COVID-19 time.

7. Findings

7.1.1 ICTs tools in international destinations

Although several different technologies are represented in the sample (Table 4), virtual tourism (31%) is the prevailing technology, followed by location-based services (21%), community informatics (17%) and Tourism Information System (14%).

Table 4. ICT tools macro-categories in international destinations

Ali and Frew's (2014a, 2014b) ICT-based tools	Frequency	%
Virtual Tourism	13	31%
Location-based system	9	21%
Community Informatics	7	17%
Tourism Information System	6	14%
Destination Management System	2	5%
Intelligent Transport System	2	5%
Environment Management Information Systems	1	2%
Economic Impact Analysis Software	1	2%
Not classified	1	2%
Total	42	100%

International DMOs enable virtual tourism to enhance sustainable destination development by providing new ways to perceive and experience the destinations (Guttentag, 2010). Virtual tourism is an umbrella grouping different sophisticated smart tools. AR applications (e.g., Pokemon Go and Discover Moscow) superimpose the destination reality to register digital information in real-time and provide interactivity between the physical and virtual environment, leaving tourists surrounded by a physical environment. VR immerses tourists in a new and completely challenging tourism experience (e.g., Japan VR, Table Rock State Park VR, and Virtual Helsinki). Diverse devices have been adopted, such as a stereoscopic head-mounted display (HDM) (e.g., Japan VR, Table Rock State Park VR), mobile smartphones (e.g., Pokemon Go, Buzzin, Virtual Helsinki), digital cameras (e.g., Faroe
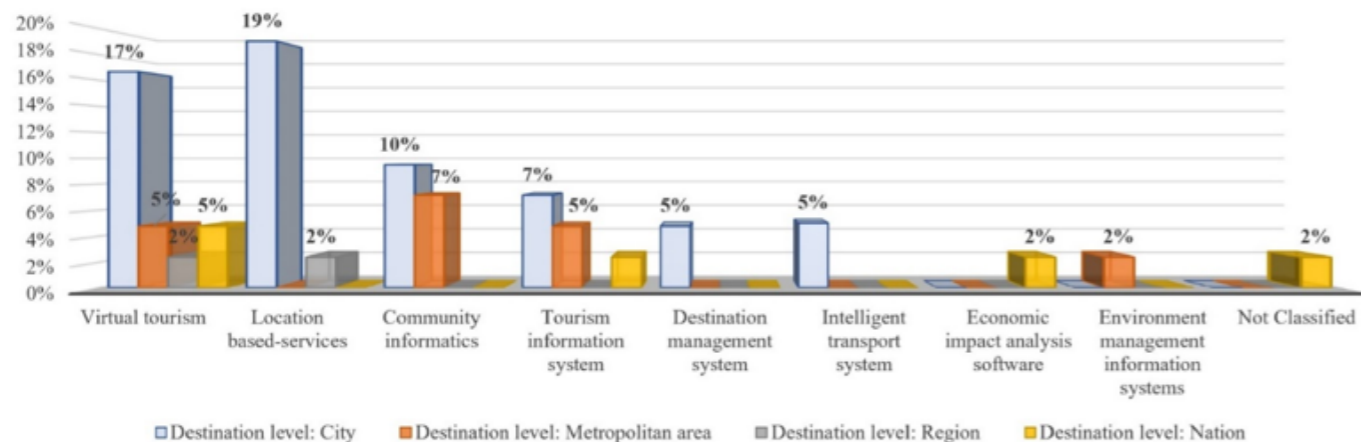
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Islands Remote Tourism), or other advanced solutions of spatial augmentation/virtualisation environment integrated with artificial intelligence and big data analysis (e.g., Virtual Singapore).

Location-based services include any ICT-applications installed in the destination that integrates different actors' geographic location with information or services (personal, technical, spatial, social and physical) tailored to that location, linked to tourism services, facilities, and attractions (Ali & Frew, 2014b, 2014a; Almobaideen et al., 2017; Pedrana, 2014). The ICT-tools analysis shows how their implementation by international DMOs has been developed using three levels of application (Pedrana, 2014): information, the type of content adapted and personalised according to the users' preferences (e.g., TravelPlot Porto app, Shakespeare a Stratford-upon-Avon app, Blind Walls Gallery Breda); technology, information is encoded and updated according to the functional device features (e.g., Stockholm Sounds, Play London with Mr Bean app, StreetMuseum app, Sheep View 360); visualisation, the information is displayed considering the tourists' information need or DMOs planning activities (e.g., MinStad app, Rock Sensors). Finally, community informatics combines and integrates tourism data from different sources into one central, real-time platform to connect local actors with tourists in participative and sharing destination development and planning activities (Ali & Frew, 2014b, 2014a; Femenia-Serra et al., 2019; Munar, 2012). They are used to assist and support tourists' decision-making processes, promoting, managing, or influencing intentions to buy or visit a destination experience (e.g., MyHelsinki, Nice Greeters, NEXTO storytelling app) or getting smart information to support DMOs planning by the analysis of personalised information, comments on online communities, spatial movements, digital information preferences or requests (e.g., WeChat Helsinki, I Amsterdam letters community, smartakartan.se Smart Map).

Figure 3 summarises the typologies of destination in which the diverse smart tools have been implemented.

**Figure 3.** ICTs tools in international destinations.

7.1.2 Digital engagement in international destinations
Smart technologies represent one of the key driver of stakeholder engagement (Cabiddu et al., 2013; Sigala & Marinidis, 2012; Trunfio & Della Lucia, 2019)we lack a clear understanding of the process by which partners co-create and share IT-enabled value. Grounded in Service-Dominant logic (S-D logic, integrating external and internal destination actors and enhancing opportunities for experience co-creation and sustainable destination development. Smart tools create virtual and cognitive spaces which enhance interaction, engagement, and co-creation.

Tourists (95%, Figure 2) constitute the external actors mostly targeted by the adopted technologies, followed by local communities (55%, Figure 2) and firms (31%, Figure 2).

Figure 4. ICTs tools for digital engagement in international destinations.
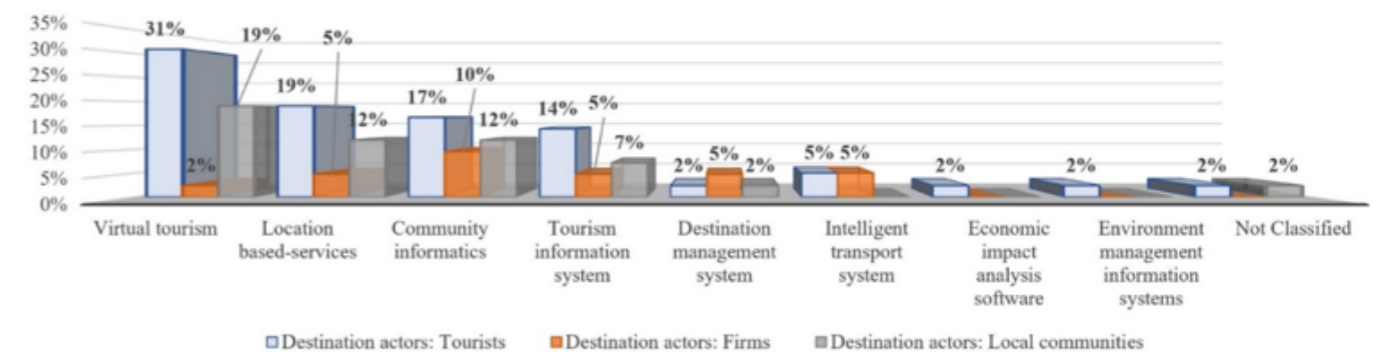
The analysis of the ICT tools based on the engaged stakeholders (Figure 4) shows the prominence of both tourists and local community, with the prevailing adoption of virtual tourism, location-based service, community informatics and tourism information systems (see Section 8.1.1).

The engagement of local firms represents an interesting aspect of the technology-driven innovation in the destination, which exploit location-based service, community informatics and tourism information systems for knowledge integration. These technologies are adopted to collect and analyse systematically information, experiences, resources, and experiences generated by different tourists and local communities (Della Lucia & Trunfio, 2018; Trunfio & Campana, 2019, 2020). Data and information collection and analysis represent an important feature supporting firms' decision-making and providing crucial inputs for the creation of innovative and sustainable offering. In this regard, specific ICT tools were adopted by local firms, such as*WeChat Helsinki, MyHelsinki, smartakartan.se Smart Map, Virtual Singapore, MinStad* and *OnlyLyon Expérience*.

7.1.3 ICTs tools for smart experiences in international destinations

Technologies engage tourists and other actors during the destination visit (80%, Figure 2), but also in the pre-experience phase (69%, Figure 2) and in post-experience (26%, Figure 2).

Figure 5. ICT tools mediating smart experiences in international destinations.
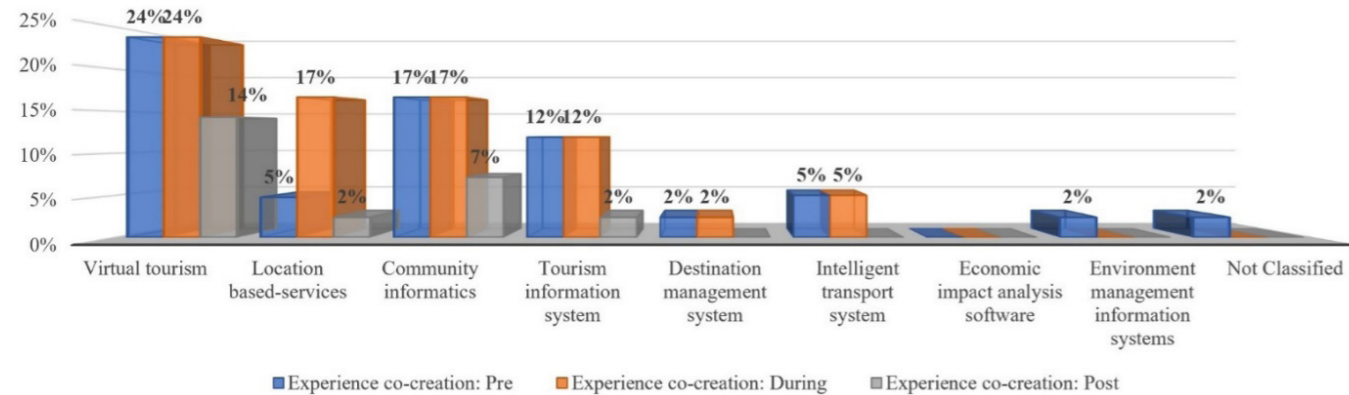
All smart tools contribute to different experience phases with diverse incidence percentage, except for economic impact analysis software, destination management system (2% pre-experience and 2% during) and environmental management information system (2% pre-experience) (Figure 5). Virtual tourism reinvents all phases of destination experience (Guttentag, 2010; Marasco et al., 2018): pre-visit (24%), on-site (24%), and post-visit (14%). It exploits VR (including virtual tours, 360° videos, virtual holograms, etc.) to promote, communicate, and assistance destination actors' decision-making processes, anticipating or replacing a real destination experience or creating virtual communities that support the sharing of tourists' experience (e.g., *Japan VR, Table Rock State Park VR, and Virtual Helsinki*). Besides, AR applies immersive technologies to facilitate on-site destination-visit, superimposing the real environment with virtual contents that improve destination exploration and stimulate tourists' interest and attention for attractions (e.g., *Buzzin, Virtual Helsinki, Pokemon Go, and Stadtgeist Karlsruhe app*).

Location-based services influence actors mainly during-experience (17%) as service sensors installed in the physical environment (Pedrana, 2014). They can be accessible in the pre-experience phase (5%) to program technology interfaces (apps) with personal preferences and information before the visit (e.g., *TravelPlot Porto*).

Finally, community informatics plays a critical role in both pre (17%) and during (17%) experience phases, followed by tourist information systems with similar values (Ali & Frew, 2014b, 2014a; Femenia-Serra et al., 2019;

Munar, 2012). They integrate different destination actors in smart processes of knowledge and experience sharing and dissemination, supporting and assisting tourists' decision making both before and during the destination-visit (e.g., *WeChat Helsinki, NEXTO storytelling app, and MyHelsinki*).

7.1.4 ICT tools for sustainable development in international destinations

Destination sustainable development is the prevailing purpose of smart tools. Diverse technologies have been adopted to address and manage destination stakeholder behaviours towards sustainable development (Figure 6), combining regulative tools (21%, Figure 2) and marketing and management tools (93%, Figure 2).

Figure 6. ICTs tools for destination sustainable development in international destinations.
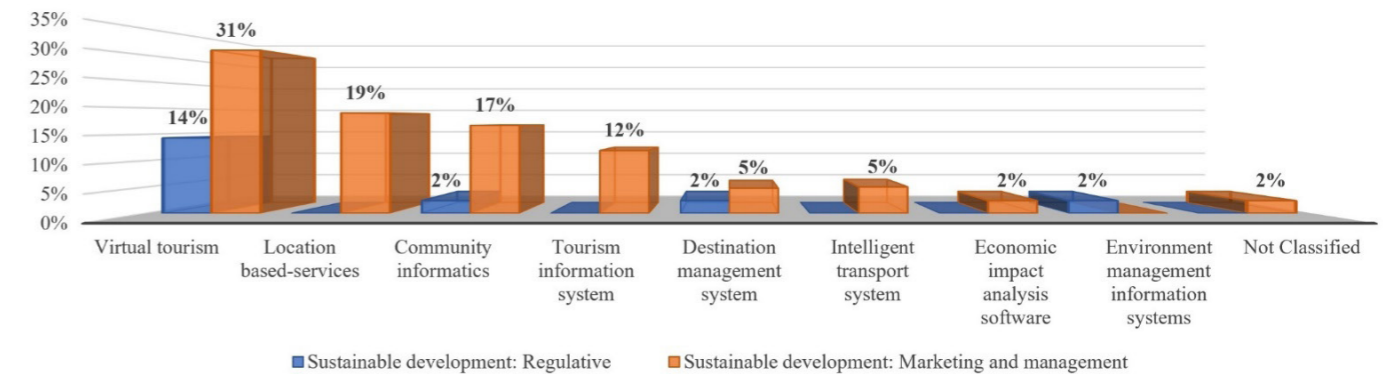
The managerial and marketing approach largely prevails at the basis of the smart tech-based actions for sustainability. Virtual tourism (31%), location-based services (19%), and community informatics (17%) are the key tools and platforms to address and manage tourism imbalances and impacts. They are implemented to redirect tourists' flows from tourist precincts towards less crowded areas, promote new thematic products and creative experiences and stimulate responsible attitudes during the visit of tourism facilities and attractions (Pasquinelli & Trunfio, 2020b). Virtual tourism tools (14%) prevail amongst those adopted by international DMOs to implement regulative actions, such as control and restriction of tourists' access to the destination (e.g., *Virtual Singapore*). Virtual tourism and location-based services exploit similar technique functionalities – e.g., location-based games, mobile interfaces (app), AR, personalised information, sensors, etc. – installed directly in the physical destination environment. Both typologies of ICT tools aim to reconfigure the urban context in a big serious gaming reality introducing innovative forms of sustainable tourism (e.g., *Pokemon Go, Buzzin, Discovery Moscow app, StreetMuseum app, TravelPlot Porto app*).

Community informatics are also envisioned as sustainability-oriented tools that transform the physical destination environment into a virtual online space for exploring and discovery the destination attractions (e.g., *WeChat Helsinki, MyHelsinki, NEXTO storytelling app*). Through community informatics, local actors can guide tourists' online exploration of less known areas and attractions, located in the outlying areas of the city destination.

7.2 Technology-driven innovation in Italian destinations

Similarly, Italian destinations levered on diverse ICT tools to support destination management pursuing digital engagement, smart experiences, and sustainable tourism (Table 5).
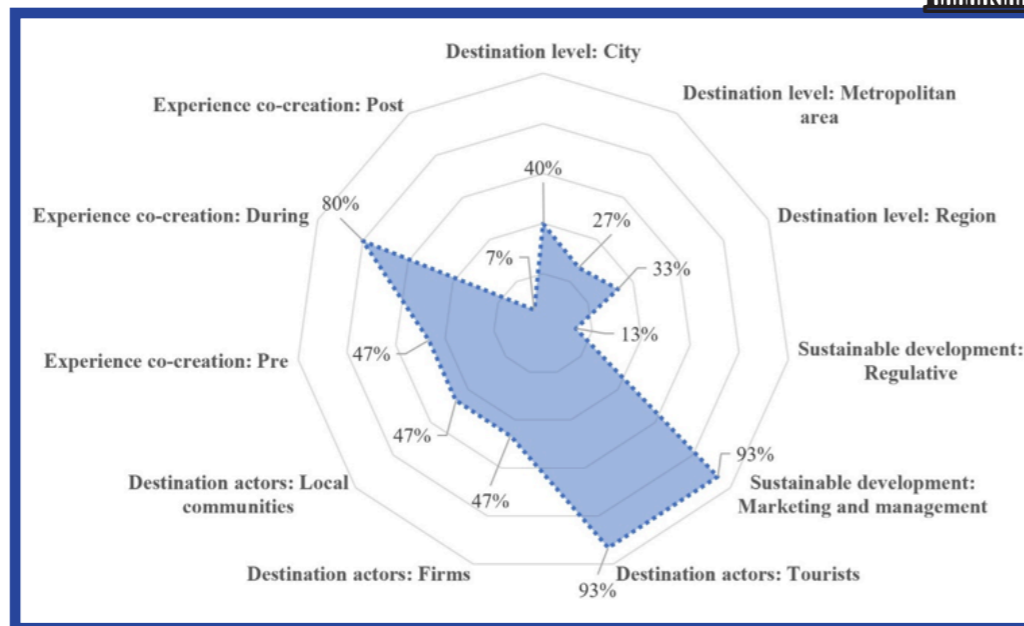
Table 5. ICT tools in Italian destinations.

Tools	Owner	Ali and Frew's (2014a, 2014b) ICT-based tools	Destination level				Sustainable		Destination actors			Experience Co-creation		
			City	Metropolitan area	Region	Nation	Regulative	Marketing and	Tourists	Firms	Local communities	Pre	During	Post
Tuscany+ AR	Tuscany region	Virtual Tourism			Tuscany			X	X				X	
BOforALL	Bologna city	Virtual Tourism	Bologna					X	X		X		X	
ExploreCity Genoa	Genoa city and ETT SpA	Virtual Tourism	Genoa					X	X				X	
Immersive Siena (Oculus)	Siena city	Virtual tourism	Siena					X	X			X	X	
#discoverbibione	Venice DMO and city	Tourism Information System	Bibione (VE)					X	X	X		X	X	
FeelàHome	Bari city and University of Bari	Tourism Information System	Martina Franca (TA)					X	X	X	X		X	
Iamiliguria	Liguria Region	Tourism Information System			Liguria			X	X	X		X	X	
Feel Florence	Florence city	Tourism Information System	Florence					X	X	X	X	X	X	
Social Ambassador Program (Blog)	Promoturismo FVG	Community Informatics			Friuli Venezia Giulia			X	X		X	X		
We-Chat miniprogram – Tuscany	We Chat and Toscana Promozione	Community Informatics			Tuscany			X	X	X		X	X	X
Digital Labs #tuscanytogether	Toscany region	Community Informatics			Tuscany			X		X				
Mowi Bike	Visit Dolomiti Paganella	Global Positioning System			Dolomiti Paganella		X	X	X		X		X	
Dolomiti Superski APP	Dolomiti SuperSKI Consortium	Global Positioning System			Dolomiti			X	X		X		X	
Venezia Unica	Venice city, Vela Spa (Avm Group), and ARTE.it	Destination Management System	Venice				X	X	X			X	X	
Junker App	Amalfi Coast Tourism Development Network	Not-classified			Amalfi Coast				X	X	X			
Total			6	4	5	0	2	14	14	7	7	7	12	1
%			40%	27%	33%	0%	13%	93%	93%	47%	47%	47%	80%	7%
Totale 15		total	15	15	15	15	15	15	15	15	15	15	15	15

Figure 7 summarises how Italian DMOs rely on ICTs, in relation to the proposed analytical dimensions.

Figure 7. The adoption of ICT tools in Italian destinations.

Cities (40%) are the most significant contexts for technological experimentation, followed by regions (33%) and metropolitan areas (27%), demonstrating a relatively smaller prominence of the urban context compared to the international sample. As in the case of international destinations sustainable development, based on the marketing and management tools (93%), represents the prevailing purpose of the smart tools' adoption. Lower, however, is the role of the smart tech-based regulative actions (13%).

Digital stakeholder engagement has been mainly adopted to engage tourists (93%), followed by local communities (47%) and firm involvement (47%). Smart technologies have been implemented mainly in the destination to support the integration between virtual and physical on-site experience (80%). Unexpectedly, the pre-experience (47%) and post-experience (7%) are underdeveloped in the Italian context, according to the analysed sample, suggesting key areas for future investments.

7.2.1 ICT tools in the Italian destinations

The three prevailing macro-categories of ICT-tools (Ali & Frew, 2014b, 2014a) adopted by Italian DMOs are (Table 6): virtual tourism (27%), tourism information system (27%), and community informatics (20%).

Table 6 . ICT tools macro-categories in Italian destinations

| Ali and Frew's (2014a, 2014b) ICT-based tools	Frequency	%
Virtual tourism	4	27%
Tourism information system	4	27%
Community informatics	3	20%
Global Positioning System	2	13%
Destination management system	1	7%
Not classified	1	7%
Total	15	100%

Virtual tourism, as in the case of international destinations, has a central positioning among ICT tools. Precisely, Italian DMOs invest in virtual tourism mainly using AR (e.g., Tuscany+ AR, BOforALL, and Immersive

Siena), followed by one VR application combined with 360° videos (e.g., ExploreCity Genoa). Both AR and VR are designed to play a marketing action to promote a destination, site, or attraction, enriching the on-site visit with digital contents and representations that improve destination information visualisation and immersion (Cranmer et al., 2020; Guttentag, 2010; Marasco et al., 2018; tom Dieck & Jung, 2017; Trunfio et al., 2020, 2021). They stimulate tourists' interactivity with multimedia characteristics, leaving untouched the physical destination environment and increasing its preservation for future tourists (Bec et al., 2019, 2021; Guttentag, 2010; Little et al., 2020; Trunfio et al., 2020). Under the technological device profile (Rauschnabel et al., 2019), AR is designed as a smart app downloadable on personal tourists' mobile devices (smartphones or tablets), ensuring higher levels of comfort and easy to use during the access to the destination information (e.g., Tuscany+ AR, BOforALL, and ExploreCity Genoa). Oppositely, VR requires the use of a sophisticated HDM (e.g., Gear VR or Controller Oculus Go) to access immersive experiences.

Like the virtual tourism, tourism information systems in Italian destinations emerge as significant tool (27%, versus 17% in the sampled internationally adopted tools). They exploit a combination of cloud computing, technology networking, and other sophisticated smart tools connected to intelligent terminal equipment to achieve, integrate, analyse, and disseminate destination information regarding tourism services, marketing, and management (Ali & Frew, 2014b, 2014a; Li et al., 2017) systematically. Consequently, the information is encoded and transmitted in real-time to smartphones or other online devices to display digital information on the destination resources (e.g., public, enterprises, and government services), tourist activities and facilities (e.g., catering, transportation, accommodation, travelling, and shopping), and other key information supporting the decision-making of multiple internal and external destination actors in the pre and during experience creation (Ali & Frew, 2014b, 2014a; Li et al., 2017). Finally, community informatics is confirmed as a key marketing ICT tool also in the Italian destinations. It identifies virtual and cognitive spaces in which multiple destination actors can meet and interact in real-time (Cabiddu et al., 2014; Femenia-Serra et al., 2019; Munar, 2012; Sigala & Marinidis, 2012; Trunfio & Della Lucia, 2019). Information sharing and dissemination is meant to support tourists' decision-making processes in the pre-visit phase of the destination (e.g., Social Ambassador Program in Friuli Venezia Giulia and We-Chat mini-program in Tuscany) or promote local actors' participation in DMOs' planning initiatives and activities (e.g., Digital Labs #tuscanytogether). Figure 8 summarises the typologies of destination in which the diverse smart tools have been implemented.

Figure 8. ICTs tools in Italian destinations.
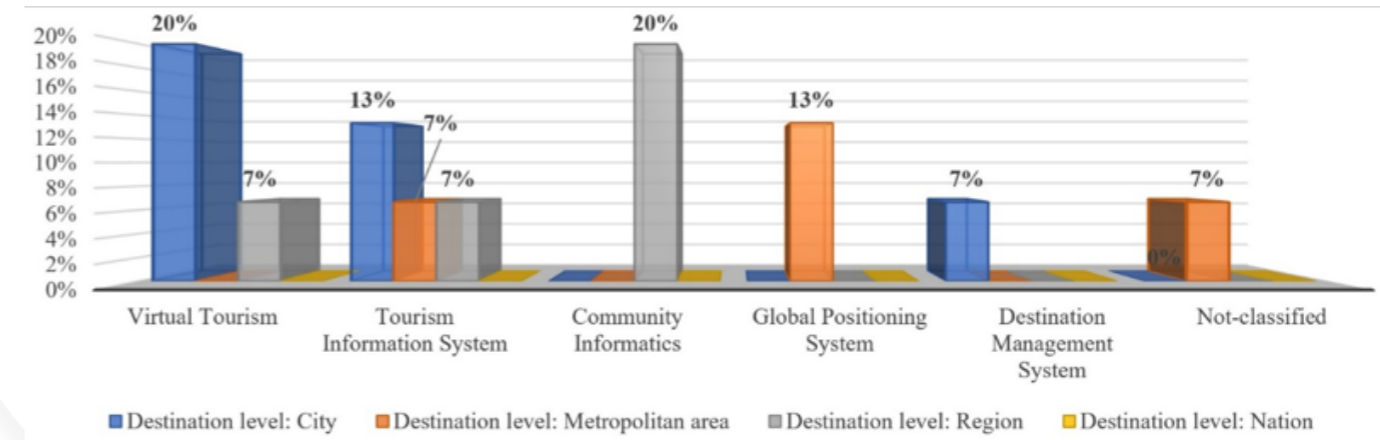
The urban context (40%, Figure 6) represents the main levels of ICT-tools implementation for sustainable development in Italian destinations, as in the international destinations. Urban destinations exploit mainly virtual tourism (20%, Figure 8) and tourism information systems (13%, Figure 8) opportunities to enhance digital engagement and immersive experiences and address unsustainable tourism imbalances. Regions mainly adopt community informatics (20%). Italian regional DMOs stimulate destination stakeholders' integration and participation in regional communities (e.g., Social Ambassador Program FVG and We-Chat mini-program – Tuscany) to acquire information, knowledge, and experiences to create development projects, enhancing liveability and quality of life for tourists and residents (Pasquinelli & Trunfio, 2020b, 2020a; Trunfio & Campana, 2020). Global positioning system is extensively implemented at the metropolitan area level (13%, Figure 8). It is used to track and analyse tourist and local actors' movements (e.g., Mowi Bike), influencing decision-making processes during the exploration of tourism activities and itineraries outside the urban context (Ali & Frew, 2014a, 2014b).

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7.2.2 Digital engagement in Italian destinations

Digital stakeholder engagement, as in the international destination, has been enhanced levering on several smart technology tools involving tourists (93%, Figure 7), firms (47%, Figure 7), and local communities (47%, Figure 7).

Figure 9. ICTs tools for digital engagement in Italian destinations.
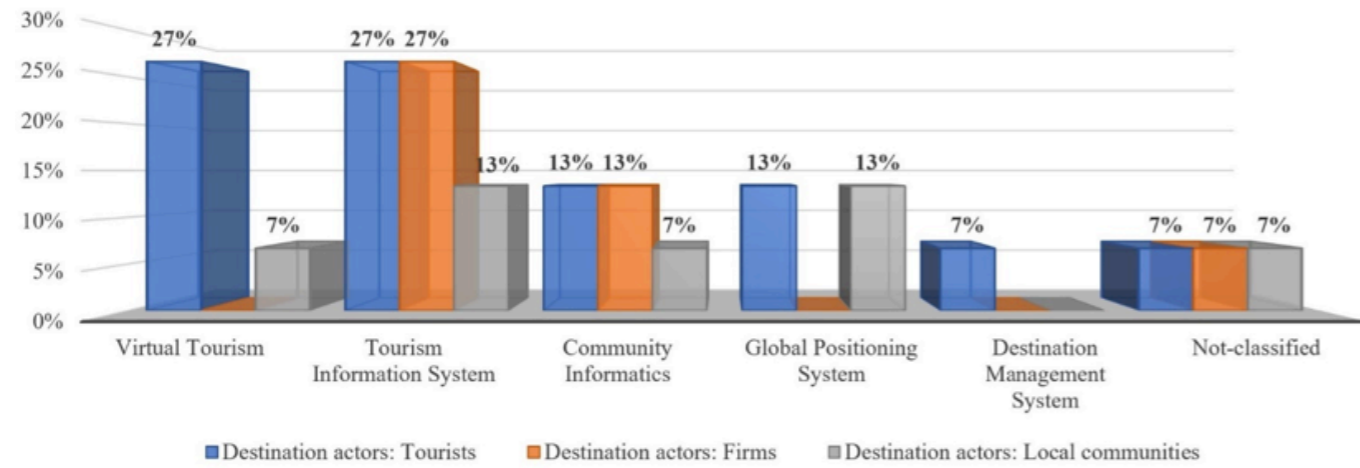
About virtual tourism, Italian DMOs mainly invested on tourists' engagement (27%, Figure 9), especially exploiting AR and VR for immersive experiences in the pre, during and post visit.

Tourism information system (27%, Figure 9) and community informatics (13%, Figure 9) represent key technological platforms in Italian destinations to promote an integration and forms of collaboration between local firms and tourists. The integration of tourists and firms on smart-technology platforms supports the transformation of tourists into destination prosumers of new thematic tourism products, services, and experiences that respond to tourists' needs and preferences (Buhalis, 2019; Buhalis et al., 2019; Buhalis & Sinarta, 2019; Chuang et al., 2017; Femenia-Serra et al., 2019).

7.2.3 ICTs tools for smart experiences in Italian destinations

Smart tourism experiences are increasing in Italian destinations, reflecting the DMOs' investments in the integration of the destination physical environment with an immersive and virtual space during the visit (80%, in Figure 7). As said, the pre-experience phase (47% in Figure 7) and post-experience (7% in Figure 7) remain marginal in smart tourism investments.

Figure 10. ICTs tools mediating smart experiences in Italian destinations.
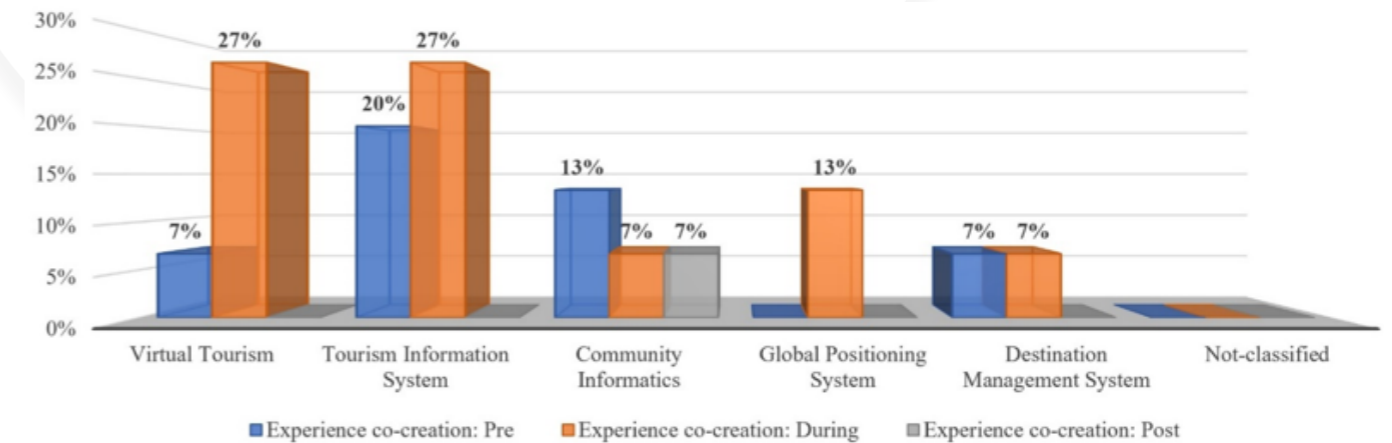
DMOs adopted several smart tools to enhance smart experiences in the diverse phases (Figure 10). Among ICT-tools (Figure 10), virtual tourism (27%) and tourism information systems (27%) represent key smart tools and platforms that enhance the technological value of the experiences in the destination. They promote tourists' innovative activities and itineraries based on virtual tourism tools which drive and shape tourists' attitudes toward responsible practices through the destination visit.

The involvement of tourists (mainly) in the pre-visit relies on tourism information systems (20%) and community informatics (13%) which support and assist tourists' decision-making processes. All the relevant information about the destination is provided and shapes tourists' intention to visit or buy a destination experience (Ali & Frew, 2014a, 2014b; Femenia-Serra et al., 2019; Li et al., 2017). The role of virtual tourism (7%) and destination management systems (7%) remain marginal in the pre-experience requiring future DMOs' investments.

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7.2.4 ICT tools for sustainable development in Italian destinations

According to the sample, Italian DMOs mainly implemented smart technology tools to achieve sustainable development through management and marketing actions (93%, in Figure 7). These tools were implemented since before the pandemic crisis to engage local actors in sharing a broad vision of sustainable development for the destination, in designing new thematic tourism products and services, and to persuade tourists to behave responsibly during their visits (Pasquinelli & Trunfio, 2020a).

Figure 11. ICTs tools for destination sustainable development in Italian destinations.
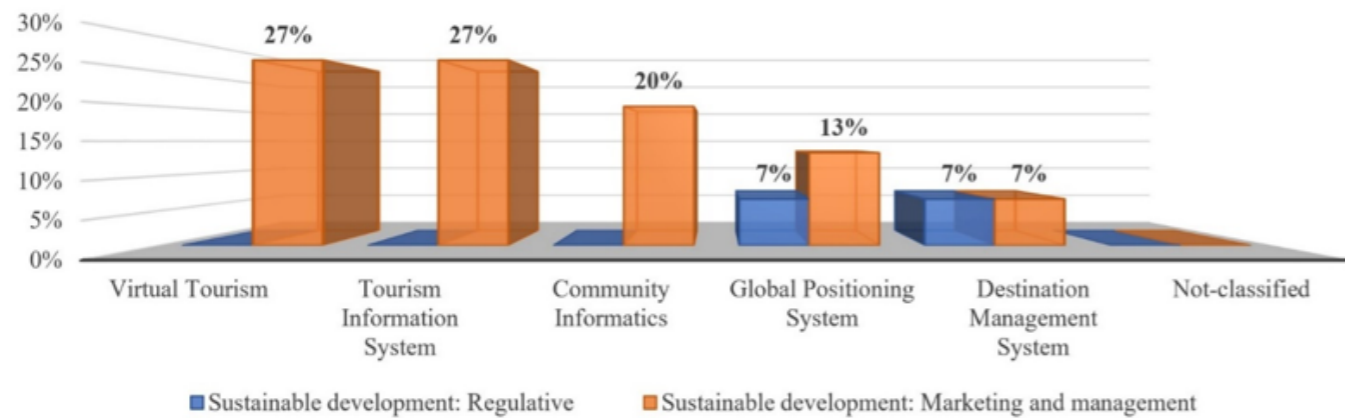
Global positioning system (7%) and destination management system (7%) are marginally adopted in the Italian context in relation to sustainability goals.

Among the tools underlying the management and marketing rationale for actions, virtual tourism continues to play a relevant role for sustainable destination management (27%). It reduces tourism impact on the destination, replacing destination physical access with virtual contents and proposing alternative itineraries, preserving and enhancing heritage, resources, and attractions (Bec et al., 2021; Pasquinelli & Trunfio, 2020b; Trunfio et al., 2020).

Italian DMOs exploit tourism information systems (27%) and community informatics (20%). Virtual communities and destination portals analyse the tourists' needs and preferences or integrate local actors in the co-design of innovative tourism experiences which aim to boost responsible attitudes during the destination visit (Ali & Frew, 2014a, 2014b; Pasquinelli & Trunfio, 2020b).

8. Emerging key points and final remarks

This exploratory research introduces fresh knowledge in the academic debate on smart and sustainable destination development. It investigates ICT tools that enhance destination smart experiences and stakeholder digital engagement and facilitate sustainable development. The research mapped and analysed the ICT tools adopted by Italian and international destinations to reach an understanding of current practices boosting stakeholder digital engagement, smart experiences and sustainable development.
Adopting a practice-led approach, this research was in charge to contribute to bridging three diverse theoretical domains – smart experience, digital engagement, and sustainable tourism – acknowledging the multidimensionality of technology-driven innovation in tourism destinations and providing empirical insights into how these multiple dimensions are operationalised. This research findings raise the attention towards the following key points, which open to future research and suggest significant managerial implications.

An integrative perspective on digital engagement, smart experiences and sustainability corresponds to the emerging ICT-based practices discussed in the research, deserving further researchers', policymakers', and practitioners' attention.

Levering on innovative ICT tools, technology-driven innovation empowers the combination of smartness and sustainability to stimulate actors' engagement with the destination and their awareness of the conflicts and imbalances tourism may provoke. These are fundamental steps to anticipate, identify, and manage urban and social issues afflicting destinations (Buhalis & Amaranggana, 2013; Del Chiappa & Baggio, 2015; Gretzel et al., 2015; Ivars-Baidal et al., 2019; Trunfio & Campana, 2019; Trunfio & Pasquinelli, 2021).

Innovative combinations of digital and physical smart experiences (across the whole customer journey) are identified as practices that, necessarily relying on multiple stakeholders' involvement, may significantly contribute to sustainability.

Smart technologies transform tourism experiences, enabling the involvement of different destination actors in the diverse phases of the experience co-creation (Neuhofer et al., 2012; Ranjan & Read, 2016). Smart technologies in the pre-experience may replace destination physical experiences, anticipating the visit or even substituting it in the COVID-19 time, enabling actors to escape from their everyday routine (Addo et al., 2020;

Gretzel et al., 2020; Sheth, 2020). Differently, post-experience may involve the sharing of digital souvenirs and memories (e.g., photos, videos, gifts) of the destination visit. Digital sharing (in post experience) creates a continuity with the destination and influences tourists' future behavioural, such as intentions to revisit or repurchase experience (Femenia-Serra et al., 2019; Munar, 2012; Munar & Jacobsen, 2014; Neuhofer et al., 2012; Ranjan & Read, 2016).

Virtual tourism's crucial role emerged in both international and Italian destinations to enhance sustainable destination development by providing new ways to perceive and experience destinations (Guttentag, 2010). Virtual tourism summarises sophisticated smart tools, such as virtual reality (VR), augmented reality (AR), mixed reality (MR), extended reality (XR), virtual holograms etc. Among them, AR and VR emerge as main applications to promote tourism destinations, sites, attractions, or events (Guttentag, 2010; Han et al., 2018; Marasco et al., 2018; Olya et al., 2020; Rauschnabel, 2018; tom Dieck et al., 2018; Trunfio et al., 2020). They combine visual multimedia characteristics (e.g., audios, sounds, texts, images, and videos) and spatial and sensory information of the physical destination to stimulate the perception 'to be there' without the tourist's physical presence (Cranmer et al., 2020; Guttentag, 2010; Marasco et al., 2018; Tussyadiah et al., 2018; Tussyadiah et al., 2018). Moreover, AR and VR embody different behavioural interactivity level by using stationary, mobile, and wearables devices (Cranmer et al., 2020; Guttentag, 2010; Kalantari & Rauschnabel, 2018; Marasco et al., 2018; Rauschnabel et al., 2019).

DMOs exploit virtual tourism (VR, virtual tours, 360° videos, virtual holograms, and other advanced technologies) to reduce tourism impact on the destination. They replace destination physical access with virtual contents, providing human-to-technology interaction with multi-sensory and multi-dimensional information that promotes immersive experience in the destination (Guttentag, 2010; Marasco et al., 2018; Tussyadiah, Wang et al., 2018). Virtual tourism reconfigures the destination context in a big serious gaming reality, promoting interaction with different digital information displayed by selecting standard itineraries or tailored to tourists' preferences. It influences and guides visit and allows discovering unusual aspects of the destination, redirecting tourists from intensely overcrowded areas toward alternative itineraries.

In addition to tourists' engagement, ICT tools may fruitfully engage locals, firms, tourism organisations and local authorities in data collection, sharing and exploitation, potentially contributing to the formation of knowledge-based tourism ecosystems pursuing sustainability.

Collecting and analysing information, needs, behaviours pre, during and post destination visit can support firms and DMOs in designing and pursuing models of sustainable tourism development. Such models can anticipate, identify and manage potential negative imbalances affecting the sustainable destination development (Pasquinelli & Trunfio, 2020a). According to Sustainable Development Goals (SDGs), the smart tools can promote inclusiveness in the destination sustainable development processes. They can be designed as online and offline virtual communities to stimulate all stakeholders' access and creation of data repository.

Acknowledging the potential of ICTs platforms to change tourism destinations radically, practitioners and policymakers are experimenting with new ways to capitalise on disruptive digital power in COVID-19 era. ICT platforms can reshape human-technology interaction in physical and virtual tourism experiences and introduce innovative tools to manage and address tourism imbalances and unsustainable stakeholder behaviours (Femenia-Serra & Neuhofer, 2018; Trunfio & Campana, 2019; Trunfio & Pasquinelli, 2021).

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