Conceptualising system resilience in smart tourism destinations

Kyriaki GLYPTOU
School of Events, Tourism and Hospitality Management
Leeds Beckett University

Miju CHOI
School of Events, Tourism and Hospitality Management
Leeds Beckett University

Abstract

Tourism destination resilience relates to a destination's ability to adapt, transform and self-organise in order to ensure enhanced system performances and quality tourism experiences. Smart tourism emerging transformations bring "*smartness*" into tourism destinations allowing the interconnection of multiple stakeholders through dynamic platforms mediated by Information and Communication Technology (ICT). This supports the prompt information exchange through machine-to-machine learning algorithms which enhance the decision-making process while encompassing attributes of innovation, inclusivity, connectivity, accessibility and poly-centricity. Smart tourism destinations thus offer an optimal ground for the exploration of emerging transformations that dictate tourism destination system foundations, as well as the level of elasticity in system element interactions and interlinkages which define a destination's resilience. This book chapter aims to explore the structural and operational advantages of smart tourism emerging transformations in the pursuit of destination resilience. Building on the case study of Glasgow, the first smart city in the UK, this chapter delineates smart tourism interventions and transformations that contribute directly and indirectly to the continuous improvement of tourism performance and experience, as well the optimization of a destination's resources in the benefit of its competitiveness and resilience.

Keywords: tourism destination resilience; smart tourism; digital transformations; Glasgow.

Introduction

Tourism is considered amongst the leading sectors to adopt early transformational processes throughout its supply chain (UNWTO, n.d.). Whether it's digital transformation or product differentiation, the tourism industry has manifested over the years strong reflexes to ensure continuous growth and innovative business solutions that safeguard both the competitiveness and sustainability of the industry. Even if such advancements are predominant at micro business level, their implementation at tourism destinations at the macro level remains fraud with challenges. With tourism destinations being continuously exposed to external disturbance and change, there comes an imperative need to establish strong grounds for their systemic resilience, to ensure their competitive market edge and maximise value for all stakeholders (Loftin, 2014).

The recognition of tourism destinations as social-ecological systems (SES) that operate over spatial and temporal scales calls for practices to cope with system disturbance in the short and longer term (Folke, 2006). This approach gains particular importance amidst times of natural and anthropogenic crises, shifts in market trends, political or socio-economic instability. Tourism destination management should thus focus on building destination resilience to secure societal development and avoid destination vulnerability. Resilience refers to the ability of a SES and a tourism destination to respond to and deal with change through adaptation and self-organisation (Walker & Salt, 2006).

At the same time, new age destinations and cities bare increasingly elements of "smartness" aiming to respond more efficiently to the emerging needs of urban residents and visitors. A smart destination not only has a smart infrastructure but also connects elements of the urban ecosystem, such as smart government, smart citizens, smart economy, smart environment and smart life. The ultimate goals of smart destinations are to improve the quality of human life and to achieve sustainable economic development (Bifulco, et al., 2016). Harrison et al. (2010) summarised the main characteristics of smart destinations in three key categories. First, a smart destination should continuously collect, analyse and distribute destination-related data that optimise efficiency and effectiveness so that networks within the destination are interconnected. Technology and data can then be used to improve the destination's competitiveness and ensure its growth. Second, common definitions and standards should be established so that data and information on destinations can be shared so that they can be easily reused. Third, a smart destination must work multifunctionally to provide solutions to various problems from a holistic destination perspective.

To ensure a dynamic destination management system that drives transition towards resilience, destinations should rather embrace uncertainty and unpredictability, and better benefit from management approaches that shape adaptability rather than approaches that aspire to control change (Berkes et al., 2003). For Folke et al. (2005) adaptive governance and management should consider four crucial interactive aspects: (a) building knowledge and understanding of system dynamics; (b) feeding knowledge into adaptive management practices; (c) supporting

flexible institutions and multilevel governance systems; and (d) dealing with external perturbations, uncertainty, and surprise. The management of CAS is thus effectuated through the development of continuous monitoring mechanisms that capture the inherent complexity of a destination system and translate knowledge into capacity for the attainment of systems resilience baring the information of feedback loops, as well as the variations of the local context.

Over the last years, the international literature has addressed more profoundly the concept of resilience in tourism destinations with an emphasis on their function as SES (Butler, 2017; Cheer and Lew, 2018; Hall et al., 2018). Despite the extensive analytical and synthetic approaches, there is still no consensus on the underlying principles for resilience-enhancement in tourism destinations and only little empirical evidence to support its operationalisation. To explore this research area with an emphasis on the features and structure of "smartness", this book chapter adopts the recognition of tourism destinations as complex adaptive socio-ecological systems and explores the relevance and application of the seven generic principles approach introduced by Biggs et al. (2012) on ecosystem services. This context offers the grounds to explore the multi-component diversity expressed though the participation and engagement of various stakeholders and information sources (action groups or institutions) that could provide multiple alternative pathways when dealing with uncertainty and responding to change (Hall et al., 2018).

Within a continuously changing socio-economic, political, health and safety and technological environment tourism destinations are prompted by circumstances to develop strong self-adaptation and self-organisation structures to ensure timely, acute and effective responses to external disturbances and speed up their recovery process. Building on the theories of SES and CAS, this conceptual study aims to explore the structural and operational advantages of the emerging transformations inherent in smart tourism destinations and their contribution for ensuring system resilience. Its theoretical contribution lies in the novel exploration of the conceptual interface between the defining principles of destination resilience and smartness thus, highlighting the contribution of emerging tourism transformations in ensuring tourism destinations adaptability and self-organisation ability. Although the study doesn't make any prominent methodological contribution, it builds on the three key components of Future City Glasgow to demonstrate applicability and relevance.

Tourism Destination Resilience

The recognition of tourism destinations as complex adaptive social-ecological systems acknowledges the plethora of underlying interactions along their dimensions and scales, their ability for self-organisation and the unexpected changes as a response to both external and internal triggers. Emphasising on ecosystem services, Biggs et al. (2012) conceptualised the enhancement of resilience in SES through the achievement of these seven principles: maintain diversity and redundancy [P1]; manage connectivity [P2]; manage slow variables and

feedbacks [P3]; foster CAS thinking [P4]; encourage learning and experimentation [P5]; broaden participation [P6] and promote polycentric governance systems [P7].

The principle of *Maintaining System Diversity and Redundancy* [P1] more specifically, allows for complementarity and the assurance that certain components could potentially cover or compensate for the inadequacy and failure of others (Walker and Salt, 2012), hence support a faster system recovery in the face of adversity. In fact, the higher the diversity and distinctiveness of system components the stronger its redundancy due to the variant timing and type of response to disturbance. In the case of tourism destinations, the response diversity encompasses the pluralism of the tourism destination facets considered, the size and strength of stakeholders involved as well as the scale of their influence and power which is usually subject to their financial and human capital (Folke et. al., 2005; Westley et al., 2013). In that regard, destination stakeholders and information agents may provide complementary and even overlapping functions through divergent trajectories and different strengths and contribution. Enhanced destination redundancy thus allows for the necessary response diversification that reduces the risk of complete system failure by minimising the possibility of a particular disturbance to horizontally and homogeneously impact all system components within the same period of time (Kotschy et al, 2015).

The *Principle of Systems Connectivity* [P2] encompasses the structure and strength of resources' and actors' interactions across the SES domains (Bodin & Prell, 2011). System connectivity is thus associated with both the speed and spread of effects across a system. Well-connected systems can overcome and recover from disturbances more quickly, but overly connected systems may lead to the rapid spread of disturbances across the entire system so that all components/actors are impacted (Dakos et al., 2015). To build resilience in SES, the principle of connectivity needs to be embedded within destinations governance. Pluralism and diversity remain paramount, as the homogenisation of knowledge, information, resources and target increases the risk of simultaneous exposure to disturbance, hence compromise the systems' resilience (Hall et al., 2018). To enhance a SES resilience through the mitigation of the negative implications of enhanced connectivity in tourism destination systems, it is important to identify vulnerable nodes and their triggers (Schoon et al., 2014). This would potentially invoke alternative connection trajectories that could either eliminate certain system nodes or provide more modular structures.

SES are characterised by a certain sense of structure and order that ensures their ability to provide ecosystem supporting, provisioning, regulating and cultural services. In that regard, Principle Three of *Managing Slow Variables and Feedbacks* [P3] of systems' configuration and functioning is achieved through the management of fundamental slow variables of ecosystem services' components and their feedback loops. In the case of tourism destination systems, examples of slow variables may include the legal frameworks, values and traditions (Berbés-Blázquez & Scott, 2017). System resilience further revolves around the management challenge of identifying and monitoring the critical system thresholds after which the system will require reconfiguration. In the case of tourism destinations this could involve the unexpected increase in tourism arrivals due to safety concerns in a neighbouring competitor, or

the promotion of low fares from the main air or tour operator. The challenge in terms of managing revolves around the strengthening of feedbacks that maintain the desirable core functions and regimes (Biggs et al., 2012), while at the same time impose stricter controls on any activities and subsidies that might obscure the feedbacks by translocating the problem or coming up with opportunistic alternatives, such as illegal accommodation provision.

Principle Four of *Fostering Complex Adaptive Systems Thinking* [P4] recognises the inherent complexity of the multidimensional dynamic connections amongst the components and actors of a SES, which goes beyond any reductionist thinking (Levin et al., 2013). To foster complex adaptive thinking in SES and more specifically in tourism destinations, it is necessary to de-code the behaviour and cognitive decision-making process of social actors. The process recognises that there is no defined or set solution to a problem, but it is more the process of setting acceptable thresholds and boundaries within which multiple interventions can be piloted (Bodin & Prell, 2011). In the context of tourism destinations, this could deter destinations from over-dependency on a single tourism product (e.g. mass coastal tourism) or a tour operator and instead develop a more flexible and adaptive approach to their supply (e.g. multiple complementary sea-based activities). Upon identifying the inter-dependencies of SES components, a structured process like scenario planning may facilitate the evaluation and feasibility of alternative trajectories based on the intended and unintended chain effect of decision making.

Principle Five on *Encouraging Learning* [P5] reflects the need for continuous information flow through monitoring and experimentation to enable system adaptation and appropriate management interventions. SES are dynamically changing and adapting systems, hence, knowledge is always partial and incomplete and exact system behaviour cannot be fully predicted (Westley et al., 2013). Other than the continuous re-iteration and data collection of learning by doing, the multi-dimensional and cross-scale learning is paramount for the development of new system norms and the enhancement of communication and building of trust on system values and the promotion of cooperation. (Olsson et al., 2004). Within a tourism destination system, learning can be encouraged and achieved through the development of a continuous monitoring system that enables the assessment of both tourism supply and demand elements, but primarily through the monitoring of the interface and interactions between the two (Glyptou et al., 2014). Management and governance structures should promote and facilitate the interaction between system components, and they should engage with participants in a variety of social contexts to share and advance knowledge and to create communities of practice.

Broadening Participation [P6] and active engagement of all system actors is fundamental for the resilience of a SES. Broad and harmonious participation among participants builds trust, consensus and reveals multiple facets and perspectives of a parameter through the expansion of depth and diversity of information (Biggs et al., 2012). It could further help set management priorities and needs and identify system perturbations. It also strengthens awareness and raise support through representing the greater well-being of the system. Participatory monitoring improves the transparency of decisions which in turn ensures enhanced relationships between

project stakeholders and ensures the comprehension and validity of information (Hall et al., 2018). Participation, if not supported by balanced power relations, might result into competition and conflict. Co-management where participation includes little authority, but much responsibility may degrade both ecosystem resilience and the ability of the system to deliver ecosystem services (Cheer & Lew, 2018). Successful participation is all about setting clear goals, expectations and objectives provide capacity building, secure sufficient resources for effective participation and deal on time with power issues and potential conflicts.

Finally, Principle Seven of *Promoting Polycentric Governance* [P7] fosters collective action among multiple governing bodies with the aim to make and enforce policy rules. Collaboration across institutions, system dimensions and scales with an emphasis on connectivity, learning and information exchange is the prerequisite for almost all other principles of resilience, particularly in the context of tourism destinations. Polycentricity abides by the contribution of nested institutions to promote social engagement and participatory processes that addresses SES challenges through collective action (Levin et al., 2013). Polycentric governance enhances tourism destinations resilience through the enhancement of pluralism and response diversity, as well as the effectuation of system redundancy that can minimise governance mechanism shortcomings. The latter is particularly relevant when moving away from national scales and policies into the specifics of local and regional destinations, where the local knowledge can be better capitalised through the encouragement of an industry culture of learning and experimentation.

Smart Tourism Destinations

In smart destinations physical, information and communication, social and business infrastructures are combined to build their collective intelligence. A smart destination improves urban life and increases the efficiency of destination management by integrating the physical and virtual urban infrastructures (Gretzel et al., 2015). Smart destinations optimise the operation of destination services using destination operation data on traffic congestion, electricity consumption and public safety events. According to Koo et al. (2016) smart destinations are marked by instrumentation, interconnection and intelligence. ‘Instrumentation’ refers to the collection of data from the real world in real time using a physical and virtual data acquisition system (Koo et al., 2016). For example, physical devices such as sensors, kiosks, meters and smartphones are used in addition to social networks to collect real-world data. ‘Interconnection’ involves integrating the collected data into a comprehensive computing platform and communicating the information generated there between various destination services. ‘Intelligence’ improves decision-making on urban management by analysing, modelling, optimising and visualising the urban management business process (Koo et al., 2016).

The initial concept of smart tourism was to provide effective customised tourism services based on real-time tourism information and location information tailored to tourists’ current situation (tourist location, time, budget, etc.) centred on smartphones (Gretzel et al., 2016).

However, it is necessary to expand the Fourth Industrial Revolution to the cooperation target of the tourism industry with robots and Information Technology (IT) that can replace human services, and to the Internet of Things (IoT) with sensor-based and network connections. Therefore, the definition of smart tourism should be extended to include renewing existing tourism methods and providing sufficient intelligent tourism services to form shared values among tourism participants and achieve mutual benefits (Gretzel et al., 2016; Jovicic, 2019). Thus, smart tourism includes not only the creation and sharing of content via smartphones, various user-customised services and social network services using Information and Communications Technology (ICT), but also the experiences of smart destination-based citizens and tourist users in smart destinations, and this concept is expanding and developing globally. Smart tourism destinations should be understood from a macro perspective that considers the impact of the tourism industry on local residents, tourism factors (tourist destinations, lodging, transportation), related industries (shopping, medical) and the national economy (Bifulco et al., 2016).

In visualising smart destinations as a system platform, a smart destination consists of three distinctive layers of information and dynamics: an infrastructure layer, a data layer and an institutional and service layer. Undoubtedly, not all ICT can be applied to the tourism field. From the perspective of tourists who are users of lodging, transportation apps and platform services, tourism experiences and products that have become more intelligent, user-friendly and efficient can be defined as smart tourism (Wang, Xie, Huang, & Morrison, 2020). The smart tourism destination is the basis and the location for such smart tourism. The smart tourism destination creates synergy by combining the technologies necessary for smart tourism into a single system and ecosystem and by the convergence of various industries, thus enhancing the quality of tourist experience and providing efficient and effective tourism services (Gretzel et al., 2016).

IoT technology has emerged rapidly with the development of ICT. Elements of the IoT can interact in real time as a connected network to recognise, manage and monitor things at anytime and anywhere. Smart devices can be used to search information related to tourism destinations and tourism experiences, leading to the creation of vast multidimensional data, commonly known as big data (Wang et al., 2020). Tourism-related organisations can gain valuable insights that can enhance the tourist destination experience based on big data from past tourists. The IoT can also create a platform for exchanging vast amounts of data, so IoT technology can also be applied in the tourism field. Smart hotels using IoT devices may also appear, and areas where ICT can be used can provide customised/real-time services to customers by analysing big data or to make payment systems more convenient through the use of fintech.

Pillars of Resilience in Smart Tourism Destinations

Adaptive tourism destination management and governance place continuous learning and information flow at the core of decision making to mitigate any effect associated with uncertainty and external disturbance to the system (Hall et al., 2018). To nurture the process of complex adaptive systems thinking, tourism destinations should move away from the fragmented management approach towards a more integrative SES management culture that embraces openness and flexibility through the recognition of the cognitive barriers of change (Westley et al., 2013). Smart tourism destinations have inherently the structure to perform as continuous monitoring mechanisms. This allows the detection and recording of slow changes that challenge the system thresholds, hence could result into a reconfiguration into a different regime (Folke et al, 2010). Table 1 presents key literature on the applications of smart tourism destinations along the seven principles of resilience to delineate the inherent "goodness of fit" between the two concepts. The literature review highlights that through the multiple agent channels of dynamic information flow and exchange, smart destinations ensure the systematic and collaborate thinking and promote connectivity and all participatory processes that foster systems resilience. Moreover, the acute interpretation of system information into action responses further establishes system resilience through the timely adaptive management interventions over changes that threaten the credibility and quality of the system or support its controlled transition into an upgraded system regime (Walker & Salt, 2012).

Table1. Alignment of Resilience Principles to Smart Tourism Destination Applications.

Principles of Resilience	Relevance to Smart Tourism Destination Applications
P1. Maintain diversity and redundancy	• IT: value, pleasure, and experiences co-creation (Boes et al., 2015) • Enhance visitor experience though product/service personalisation and awareness of available tourism services (Lamsfus et al., 2015) • Infrastructure and accessibility (Lopez de Avila, 2015; Coca-Stefaniak, 2019) • Market ties (Coca-Stefaniak, 2019) • Smart-tailored services and applications for co-creation (Cavalheiro, 2020)
P2. Manage connectivity	• ICT: dynamic interconnection of multiple stakeholders to support prompt information exchange (Buhalis & Amaranggana, 2013) • ICT: visitor's interaction with and integration into surroundings and increases the quality of the experience at the destination (Lopez de Avila (2015) • ICT: knowledge-based destination, as a technological platform for instant exchange of tourism information and knowledge (Jovicic, 2019) • Tourism integrated information platform (Cavalheiro et al., 2020)
P3. Manage slow variables and feedbacks	• Tourism product diversification resulting into wealth, profit, and benefits for the organisations and the destination (Boes et al., 2015). • Enhanced economic, socio-cultural, political and ecological value (Cavalheiro et al., 2020)

P4. Foster complex adaptive systems thinking	• Dynamic machine-to-machine learning algorithm (Buhalis & Amaranggana, 2013) • ICT: self-operation and automation: cloud services, internet of things (IoT), and end-user internet service system, are typically recognised for their indispensable roles in realising smart tourism destinations (Koo et al., 2016) • AI Technology (Wang et al., 2016) • Destination Intelligence (Ivars-Baidal et al., 2019) • Smart Innovation (Coca-Stefaniak, 2019)
P5. Encourage learning	• ICT: knowledge-based destination, as a technological platform for instant exchange of tourism information and knowledge (Jovicic, 2019) • AI Technology (Wang et al., 2016) • Full smart experience: Smart tourists-smart destinations (Femenia-Serra et al., 2019)
P6. Broaden participation	• Full smart experience: Smart tourists-smart destinations (Femenia-Serra et al., 2019) • Smart experience co-creation: interaction, sharing, active participation (Cimbaljević et al., 2019). • Integration, coordination and cooperation among stakeholders (Cavalheiro et al., 2020).
P7. Promote polycentric governance systems	• Interconnection of multiple stakeholders to support prompt information exchange, hence, enhance their decision-making process (Buhalis & Amaranggana, 2013) • Empowering destination management organisations and local stakeholders to make decisions and take actions based upon the data produced in within the destination, gathered, managed and processed by means of the technology infrastructure (Lamsfus et al., 2015).

Case Study: Future City Glasgow

In 2013, Glasgow received £24 million in funding from the Technology Strategy Board (now Innovate UK) under the Department for Business, Innovation and Skills to use the latest science and technology to conduct a project to make urban life smarter, safer and more sustainable (Leleux & Webster, 2018). The Technology Strategy Board provided 30 British cities with £50,000 each to study ways to use new technologies to improve urban life in the areas of transport, housing, health, energy and the environment. Glasgow was selected as the first demonstration smart city in the UK, overtaking the 29 other cities with an application focusing on urban mobility, cycling and walking, energy, public mobility support services and public safety (Innovate UK, 2017). Since receiving funding from the UK government in 2013, the City of Glasgow has implemented many of its proposals, including updating the central transport and public safety control centre with the latest science and technology, achieving big and open data, developing an app that allows easy and simple communication between citizens and local governments, and improving urban mobility and urban energy consumption (Leleux & Webster, 2018). Glasgow's smart city project, entitled Future City Glasgow, includes three

major components – the Glasgow Operations Centre, Open Glasgow and Four Demonstrators – and features energy efficiency, integrated social transport, intelligent street lighting and active travel, which promote directly or indirectly resilience at tourism destination level.

1. Glasgow Operations Centre

The Glasgow Operations Centre established an up-to-date central traffic and public safety control system. The centre is equipped with central operation and access to over 500 public CCTVs that have been upgraded to full HD to share video information with the police. It provides real-time central traffic management and features a central control system using 800 traffic signals and a real-time notification system in case of emergency using the latest video analysis technology. In addition, the centre provides central security management for municipal museums and art galleries. Other than ensuring the *Management of Connectivity* [P2] through the dynamic interconnection of information agents and sources, the central Glasgow Operations Centre serves a continuous monitoring system that fosters *Complex Adaptive Systems Thinking* [P4] which contributes to the *Management of Slow Variables and Feedbacks* [P3] and the nurturing of Polycentric Governance Systems [P7].

2. Open Glasgow

The Open Glasgow project aims to strengthen innovation and capacity in all areas of the community by increasing the accessibility of data to citizens, academia, companies and the *public through the Internet.* In an era in which a large amount of information is rapidly produced by research institutions, the Open Glasgow initiative greatly aligns with the resilience principle on *Broadening Participation* [P6] and *Encouraging Learning* [P5]. Data collected by 60 different research organisations on Glasgow's population, economy, education, environment, geography, energy, health, life, public safety, travel and transport can be easily accessed by anyone regardless of location, which then ensures both the *Management of Connectivity* [P2] and *Slow Variables and Feedbacks* [P3].

In fact, the city of Glasgow is carefully evaluating the impact and ripple effects of making big data widely available in the following areas.

- Partnership development through increased understanding of cities and communities
- Promotion of communication and cooperation between the community and its service providers
- Urban planning and urban regeneration development
- Improvement of the services provided in the city
- Participation in the policy-making process
- Increasing innovation that promotes urban economic growth
- Increased information transparency

3. Four Demonstrators

The Four Demonstrators project is designed to increase the energy efficiency of buildings in Glasgow and expand the use of low-carbon energy. In collaboration with Integrated Environmental Solutions (a firm located in Glasgow), a 2D/3D map was developed of the energy consumption of residential and commercial buildings throughout the city based on information provided by Glasgow citizens. Through the different facets of the four demonstrators (building efficiency, integrated social transport, intelligent street lightning and active travel), the initiative allows the personalisation and co-creation of experiences between service providers and consumers which aligns with the *Maintaining of Diversity and Redundancy* principle [P1] with clear and direct applications for the tourism system. Additionally, the energy efficiency project may effectuate the measurement of pollutant emissions and the indirect costs of fuel shortage through accurate information collection, which supports the *Management of Slow System Variables and Feedbacks* [P3] and *Foster Complex Adaptive Systems Thinking* [P4] through the continuous monitoring and automation of processes.

Building efficiency: When a user enters information about the building in which he or she lives or works through the website or app, the building's actual energy consumption and the results of a simulation that calculates the expected energy consumption can be compared (Innovate UK, 2017). This information can be used by tourism service providers to offer services at a lower cost and by users themselves to increase the energy efficiency during their chosen operations. The figures provided by users contribute to the development of a 3D energy model that allows to geographically determine actual energy consumption and consumption patterns in Glasgow and the effects of each action taken to increase energy efficiency.

Integrated social transport: The MyGlasgow app was initially developed to allow Glasgow citizens to report problems related to roads, traffic signals, street cleanliness and garbage collection, and to check on the problem-solving process and receive feedback. The app has been then used my Glasgow visitors and tourists as well. The Social Transport app enables those who are vulnerable due to physical difficulty to receive free transport services provided by the city. Integrated Social Transport has helped Glasgow's most vulnerable citizens access social and educational services. The smart wayfinding scheduling software reduces operating costs while improving the flexibility and responsiveness of service provision.

Intelligent street lighting: Real-time motion/noise recognition sensors are equipped with a notification function for police and emergency rescue teams and, in the case of an emergency, the accident location is indicated by a blinking signal. The system improves understanding of the city and city planning by collecting data on air pollution and the movement of the population through its measurement system.

Active travel: Apps created through Active Travel were able to create a more friendly environment for travellers by helping pedestrians and cyclists plan their travel routes, monitor traffic congestion and record their travel. Community participation in the development process played an important role in data collection and city mapping. Through this programme, Glasgow was able to explore the possibility of creating an environment in which 10% of travel is by bicycle, a target set by the Scottish government.

Smart Tourism Transformations and Destination Resilience

While new age destinations and cities aim to increasingly adopt emerging transformations of "smartness" and respond more efficiently to the needs of urban residents and visitors, their adaptive governance and management approach in the context of SESs, establishes consideration of human activity within the broader destination system. Traditional destination governance and management approaches that fail to capture the chain dynamics of a tourism destination system as a whole, often result in transposing rather than solving problems. A system thinking approach that extends to all the facets of the tourism destination product is thus essential to capture the whole spectrum of system dynamics and to strengthen its capacity to respond to unexpected events and disturbances.

Whether it is digital transformation, product differentiation or service enhancement, tourism destinations engage in the race of adopting smart innovative transformations to safeguard their competitive edge and to ensure high quality tourist experience. As demonstrated by the Glasgow case study, behind each transformation in smart tourism lay elements of polycentricity, multi-layering, network structure learning and collaborative innovation. Smartness extends beyond just infrastructure to connect elements of the urban ecosystem such as smart government, smart citizens, smart economy, smart environment and smart life. Emerging transformations in destinations infused with elements of smartness appear to contribute to the three key categories identified by previous works (e.g. Boes et al., 2015; Harrison et al., 2010, Ivars-Baidal et. 2019, Shafiee et al., 2019) namely: (a) contribute and support the continuous collection, analysis and distribution of destination-related data that optimise network effectiveness hence support a destination's competitiveness and ensure its growth; (b) enhance consistency among definitions and standards so that data and information on destinations can be shared so that they can be easily reused; and (c) ensure multifunctionality to provide solutions to various problems from a holistic destination perspective.

By adopting such robust tourism structures that lay the basis for their resilience, tourism destinations will be able to adapt, self-reorganise and hence effectively respond to external shocks and drivers of change that prevail the continuously changing environment that we are experiencing. Tourism destinations are inherently subject to socio-economic, technological, political and health and safety externalities and crises that could dramatically change their

performance within a very short period of time. Building destinations resilience through smart emerging transformations sets the grounds for effective and timely responses to crises with a stronger system ability for self-regulation and hence spill over disturbance control throughout all system elements. A controlled and evidence supported response is key for an effective and swift recovery of the system, to either its initial state or a new adapted equilibrium of full functionality that is based on all seven principles and core values of system resilience.

Conclusion

This conceptual study explores the structural and operational advantages of digital transformations related to smart tourism destinations in their pursuit of tourism system resilience. It contributes to smart tourism destination literature by aligning destination resilience and smart tourism destinations. The discussion shows that seven aspects of resilience are relevant to smart tourism destination applications for delineating the inherent goodness of fit of the two concepts. For example, 'maintaining diversity and redundancy' is aligned with the infrastructure and accessibility of smart tourism destinations and with smart-tailored services and applications for co-creation. 'Managing connectivity' is aligned with visitors' interactions with and integration into the surroundings, and it increases the quality of the experience at the destination through ICT. Building on the case study of Future City Glasgow, this study delineates smart tourism interventions and applications that contribute directly and indirectly to the continuous improvement of tourism performance and tourists' experiences, as well as to the optimisation of a destination's resources to benefit its competitiveness and resilience. The seven principles of resilience are discussed in terms of their application to three major components of Future City Glasgow.

Despite its academic contributions, this study has some limitations. Caution is required in generalising the findings of a limited case study. Governments worldwide strive to enhance citizens' lives by making urban life smarter, safer and more sustainable. Tourists and visitors enjoy the benefits of such interventions during the stay and destination interactions as well. Findings from the Glasgow case study reveal that currently smart applications are embedded at destination level structures without necessarily a deliberate consideration of the tourism sector nor tourism experience. System resilience is thus primarily operationalised along the attributes of the whole destination system and not only its tourism ecosystem. The nesting of smart tourism ecosystem within the overall destination smartness operationalisation is inherently aligned with the concept of resilience. It is however important for tourism practitioners and researchers to explore the specifics of tailor-made smart applications in the tourism and hospitality industry in order to understand better the benefits and challenges of their implementation and adoption within the tourism industry and tourism destination ecosystem. Future research should thus, consider a number of tourism destinations of varying tourism products and life cycle stages, to explore the alignment of resilience principles with designated smart tourism applications at destination level.

References

Berkes, F., Colding, J., & Folke, C. (Eds). (2003). *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge, UK: Cambridge University Press.

Berbés-Blázquez, M., & Scott, D. (2017). The development of resilience thinking. In: Butler, R.W. (ed). (2017). *Tourism and Resilience* (pp. 9-22). Wallingford, UK: CABI.

Bifulco, F., Tregua, M., Amitrano, C. C., & D'Auria, A. (2016). ICT and sustainability in smart cities management. *International Journal of Public Sector Management*, *29*(2), 132-147.

Biggs, R., Schlüter, M., Biggs, D. et. al. (2012). Towards principles for enhancing the resilience of ecosystem services. *Annual Review of Environment and Resources*, *37*, 421–448.

Bodin, O., & Prell, C. (Eds). (2011). *Social Networks and Natural Resource Management: Uncovering the Social Fabric of Environmental Governance*. Cambridge, UK: Cambridge University Press.

Boes, K., Buhalis, D., & Inversini, A. (2015). Conceptualising smart tourism destination dimensions. In: *Information and communication technologies in tourism 2015* (pp.391-403). Cham: Springer.

Buhalis, D., & Amaranggana, A. (2013). Smart tourism destinations. In: *Information and communication technologies in tourism* 2014 (pp.553-564). Cham: Springer.

Butler, R.W. (Ed). (2017). *Tourism and Resilience.* Wallingford, UK: CABI.

Cavalheiro, M. B., Joia, L. A., & Cavalheiro, G. M. D. C. (2020). Towards a Smart Tourism Destination Development Model: Promoting Environmental, Economic, Socio-cultural and Political Values*. Tourism Planning & Development, 17*(3), 237-259.

Cheer, J.M., & Lew, A.A. (Eds.). (2018). *Tourism, Resilience and Sustainability: Adapting to Social, Political and Economic Change.* London and New York: Routledge.

Cimbaljević, M., Stankov, U., & Pavluković, V. (2019). Going beyond the traditional destination competitiveness–reflections on a smart destination in the current research. *Current Issues in Tourism*, *22*(20), 2472-2477.

Coca-Stefaniak, J. A. (2019). Marketing smart tourism cities–a strategic dilemma. *International Journal of Tourism Cities, 5*(4), 513-518.

Dakos, V., Quinlan, A., Baggio, J.A., Bennett, E., Bodin, O., & BurnSilver, S. (2015). Principle 2-Manage connectivity. In: Biggs, R., Schluter, M., & Schoon, M.L. (Eds) (2015). *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (pp.80-104). Cambridge, UK: Cambridge University Press.

Femenia-Serra, F., Neuhofer, B., & Ivars-Baidal, J. A. (2019). Towards a conceptualisation of smart tourists and their role within the smart destination scenario. *The Service Industries Journal, 39*(2), 109-133.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social–ecological systems. *Annual Review of Environment and Resources*, *30*, 441–473.

Folke, C. (2006). Resilience: the emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, *16*, 253–267.

Folke, C., Carpenter, S.R., Walker, B.H., Scheffer, M., Chapin, T., & Rockstrom, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society*, *15*(4): 20. Available from: http://www.ecologyandsociety.org/vol15/iss4/art20/ (accessed 10/11/2020).

Glyptou, K., J.A. Paravantis, A. Papatheodorou, & Spilanis, I. (2014). Tourism Sustainability Methodologies: A Critical Assessment. In *IISA 2014: The Fifth International*

Conference on Information, Intelligence, Systems and Applications, (IEEE Eds.), (pp.182-187). Los Alamitos, CA: IEEE Computer Society.

Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: foundations and developments. *Electronic Markets, 25*(3), 179-188.

Gretzel, U., Zhong, L., Koo, C., Boes, K., Buhalis, D., & Inversini, A. (2016). Smart tourism destinations: ecosystems for tourism destination competitiveness. *International Journal of Tourism Cities*, *2*(2), 108-124.

Hall, M.C., Prayag, G., & Amore, A. (2018). Tourism and Resilience: Individual, Organisational and Destination Perspectives. Bristol, UK: Channel View Publications.

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P. (2010). Foundations for smarter cities. *IBM Journal of research and development*, *54*(4), 1-16.

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, *4*, 390–405.

Innovate UK. (2017). *Innovate UK: About us*. Available from: https://www.gov.uk/government/organisations/innovate-uk (accessed 11/11/2020).

Ivars-Baidal, J. A., Celdrán-Bernabeu, M. A., Mazón, J. N., & Perles-Ivars, Á. F. (2019). Smart destinations and the evolution of ICTs: a new scenario for destination management? *Current Issues in Tourism, 22*(13), 1581-1600.

Jovicic, D. Z. (2019). From the traditional understanding of tourism destination to the smart tourism destination. *Current Issues in Tourism*, *22*(3), 276-282.

Koo, C., Shin, S., Gretzel, U., Hunter, W. C., & Chung, N. (2016). Conceptualization of smart tourism destination competitiveness. *Asia Pacific Journal of Information Systems*, *26*(4), 561-576.

Kotschy, K., Biggs, R., Daw, T., Folke, C., &West, P. (2015). Principle 1-Maintain diversity and redundancy. In: Biggs, R., Schluter, M., & Schoon, M.L. (Eds) (2015). *Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems* (pp. 50-79). Cambridge, UK: Cambridge University Press.

Lamsfus, C., Wang, D., Alzua-Sorzabal, A., & Xiang, Z. (2015). Going mobile: Defining context for on-the-go travelers. *Journal of Travel Research*, *54*(6), 691-701.

Leleux, C., & Webster, W. (2018). Delivering smart governance in a future city: The case of Glasgow. *Media and Communication, 6*(4), 163-174.

Levin, S., Xepapadeas, T., Crépin, A. S. et al. (2013). Social–ecological systems as complex adaptive systems: modeling and policy implications. *Environment and Development Economics*, *18*, 111–132.

Lopez de Avila, A. (2015, February). Smart destinations: XXI century tourism. In Tussyadiah, L., & Inversini, A. (Eds) *ENTER2015: Information and Communication Technologies in Tourism 2015* (pp. 4-6), Switzerland: Springer International Publishing.

Olsson, P., Folke, C., & Berkes, F. (2004). Adaptive co-management for building resilience in social–ecological systems. *Environmental Management*, *34*, 75–90.

Schoon, M.L., Baggio, J.A., Salau, K., & Janssen, M. (2014). Insights for managers from modeling species interactions across multiple scales in an idealized landscape. *Environmental Modelling and Software*, *55*, 53–59.

Shafiee, S., Ghatari, A. R., Hasanzadeh, A., & Jahanyan, S. (2019). Developing a model for sustainable smart tourism destinations: A systematic review. *Tourism Management Perspectives, 31*, 287-300.

Walker, B. H., & Salt, D. (2012). *Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function*. Washington, DC: Island Press.

Wang, X., Li, X. R., Zhen, F., & Zhang, J. (2016). How smart is your tourist attraction?: Measuring tourist preferences of smart tourism attractions via a FCEM-AHP and IPA approach. *Tourism Management, 54*, 309-320.

Wang, J., Xie, C., Huang, Q., & Morrison, A. M. (2020). Smart tourism destination experiences: The mediating impact of arousal levels. *Tourism Management Perspectives, 35*, 100707.

Westley, F., Tjornbo, O., Schultz, L., Olsson, P., Folke, C., Crona, B., & Bodin, O. (2013). A theory of transformative agency in linked social–ecological systems. *Ecology and Society*, *18*(3), 27. Available online: http://dx.doi.org/10.5751/ES-05072-180327 (accessed 10/11/2020).