International Journal for Quality Research 16(1) 285–306
ISSN 1800-6450

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Article info:
Received 17.02.2021.
Accepted 05.05.2021.

UDC – 338.48:005.74
DOI – 10.24874/IJQR16.01-20

SYSTEMS APPROACH TO MODEL SMART TOURISM ECOSYSTEMS

Abstract: *The tourism industry is inherently complex and a key player in sustainable development. This paper intends to discuss the path towards building a sustainable smart tourism ecosystem model by delving deep into the pivotal topics with interesting speculations on smart cities' perspectives that lay a broader foundation of smart tourism destinations. First, it discusses the interconnections and foundation of smart tourism ecosystems by proposing a general conceptual model describing traditional tourism transformation through ICTs. Second, by explicating each building block of smart tourism ecosystems and using systems methodology (systems thinking method and qualitative modeling in a frame of system dynamics) to break down the complex system of smart tourism's roles and components. Such methods are widely utilized in different fields of study to facilitate the decision-making process by furnishing a holistic view of the problem. For that matter, Causal Loop Diagramming (CLDs) was used as one of the powerful tools of systems thinking to depict smart tourism ecosystems. The proposed causal loop diagram considers sustainability as one of the main concerns and trying to shed some light on intricate networks of businesses, socio-economic, and environmental subsystems in smart tourism destinations that are performing distinctively yet interdependent. This study is an ongoing process employing System Dynamics (SD) methodology for model testing and validation.*

Keywords: *Smart Tourism Destinations; Smart Ecosystems; Sustainable Tourism; Complex Systems; Systems Methodology.*

1. Introduction

As a highly complex system, the tourism industry has proven itself as a key player in sustainable development. From a systems point of view, sustainable tourism is grounded in the holistic perspective, in which systems thinking can provide a powerful tool for illustrating the world and uncovering the interconnections between the components of the systems. The adoption of systems thinking and a holistic approach to promote understanding of tourism problems and tourism systems is justified on the grounds that the components of the tourism industry interact with each other and offer the same final product, which is an attraction and experience for tourists (J. Baggio & Baggio, 2020; Batat & Prentovic, 2014; Sánchez et al., 2006). Ecosystems mainly emphasize the holistic view rather than focusing on components of systems by recognizing how small changes can have substantial effects,

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encourages a focus on complex relationships, stresses dynamic changes (Gretzel, Werthner, et al., 2015). Moreover, this paper draws attention to the technical definition by Boley & Chang (2007) using the term digital ecosystem by pointing out on the characteristics of these ecosystems, such as flexibility, openness, demand-driven, interactivity.

The complexity of the problems that emerge in tourism systems, due to the diversity of interests of the different stakeholders and the dynamic and non-linear nature of the interactions between the different components of the systems, has discouraged the use of linear thinking. Systems approach thus represents an excellent methodology with its methods of systems modeling and simulation (Jere Jakulin, 2017). Integrating the feedback structures and smart tourism ecosystems help us create a simple conceptual model to illustrate all the leverage points for creating a sustainable system. The collision of population, economic growth, and technology with limited resources on our planet will lead to new challenges for managing sustainability. Concurrently, cities are growing in number and population and desperately seeking a solution to become more efficient and sustainable. Cities are composed of multiple sectors incorporating technologies to provide more efficient service for citizens and tourists. This study uses the systems thinking approach as a powerful tool to develop a conceptual model (causal loops diagram) of smart tourism ecosystems by illustrating the most influential interconnections among such systems' components. The intention is to create a new perspective for looking at the complexity of smart tourism ecosystems and to call-out the necessity of using the human-centered approach in the smart destination, which could provide a more robust backbone for providing sustainability in the long run.

Considering the above premises outlined, this paper intends to discuss the path towards building a sustainable smart tourism ecosystem model by delving deep into the pivotal topics with interesting speculations on smart cities' perspectives that lay a broader foundation of smart tourism destinations. Henceforth, the section -a base of sustainable tourism- scrutinizes sustainability and tourism's complex characteristics and the shifting towards nonlinear thinking as a sine qua non. Then, the study describes the background and roadmap from smart cities to smart tourism destinations. Next, by diving more in-depth in the concept of ecosystems, this paper portrays the process of utilizing smart technologies to shape the smart tourism ecosystems as an initial conceptual model. The remainder of the paper explains systems thinking as the research methodology and illustrates the interconnectivity of six building blocks of smart cities. Afterward, key variables of smart tourism ecosystems are identified, and the relationships among the variables are then illustrated as a causal loop diagram (CLD). The final section concludes the contributions, implications, limitations, and future research areas.

2. A base of sustaınable tourısm

Every natural system strives to achieve a state of homeostasis or balance among its components. Organizational systems, among them is tourism, are organized by people, we call the soft systems, since they react according to their knowledge, emotions, political decisions, which are many times far away from keeping balance among system’s components regardless being local or global. The success or failure of a tourism development initiative or strategic plan is largely dependent on whether the decision-makers truly understand the interaction and complexity of the system he or she is trying to influence (Jere Jakulin, 2020). To achieve balance among tourism components the decision-makers must start to think in terms of sustainable or systems decision-making, where all of the resources (components) represents balanced tourism system within the natural environment. As one of the fastest-growing industries in the world, tourism

deemed as an economic sector (R. Baggio, 2013) contributing to job creation, poverty alleviation, and has a direct impact on the economic, environmental, and social sustainability of destinations (Sinclair-Maragh & Gursoy, 2016; UNWTO, 2017). Over the past decades, the idea of sustainability has become the main driving force in forming the economic and political structures of the tourism system (Bramwell & Lane, 1993; Saarinen, 2006), and many other authors were talking about sustainability in a context of "the limit to growth" (Meadows et al., 1972), "Our Common Future" (Brundtland et al., 1987), the equilibrium among socio-economic, environmental, and political systems (Boluk et al., 2019, Saarinen, 2006) all of them are complex systems, which function in a nonlinear manner (R. Baggio, 2008; Clarke, 1997; Leiper, 1990; Liu, 2003; McDonald, 2009; McKercher, 1999; Sainaghi & Baggio, 2017; P. Sedarati et al., 2018) and needs to be managed by an approach that would anticipate it's future behavior in and sustainability within the environment. The path towards developing sustainable tourism can be somehow precarious due to the multisectoral nature of tourism wherein a multitude of stakeholders are involved; thus, moving towards a much more comprehensive view of systems and using a holistic approach would be crucial (Boluk et al., 2019; McDonald, 2009).

3. Smart cities and smart tourism destination

Cities are growing bigger every day both in numbers and populations by witnessing a gradual shift in the tendency to live in urban areas. To solve the unpredictable behavior of cities' ecosystems, systems approach and systems thinking can offer a solution to decision-makers and planners to fathom better how inextricably interrelated all sectors of a city are (Boluk et al., 2019). To ensure a better quality of life, a more livable environment, and prosperity of the place, thus, cities are seeking smarter ways to overcome the aforementioned issues (Chourabi et al., 2012; Giffinger & Pichler-Milanović, 2007).

The idea of smart cities initially started in the early 2000s with a technology-centric view for development Smart City 1.0. (Mckinsey Global Institute, 2018).The second era of smart cities (Smart City 2.0) with a multisectoral and human-centered approach had a focus is on the quality of life the citizens (De Guimarães et al., 2020; Giffinger & Pichler-Milanović, 2007; Harrison et al., 2010; Pencarelli, 2019; Woetzel & Kuznetsova, 2018; Yeongbae et al., 2017).

The framework of smart cities was initially developed by Giffinger et al. (2007) where they identified six core components of a smart city: Smart People; Smart Economy; Smart Environment; Smart Governance; Smart Living; and Smart Mobility, which later on was further developed by Boyd Cohen (2013) with a much more holistic view of the smart cities.

The three main characteristics of a smart city "instrumented, interconnected and intelligent" were developed IBM and explained their meanings. Instrumented is the ability to capture real-time data through the presence of multiple sensors, meters, and other similar "data-acquisition systems". Interconnected can be defined as a bridge between the physical and virtual world, in which the captured information through instrumentation allows different sectors to communicate much efficiently. Ultimately, the interconnected information coupled with the complex analytical power furnishes decision-makers with a much more intelligent and optimal solutions (Dirks et al., 2009; Dirks & Keeling, 2009; Harrison et al., 2010).

The tourism industry, as one of the sub-systems of smart cities, utilizes information communication technology (ICT) in tourism destinations to foster several aspects such as improving infrastructures, monitoring and managing tourism hotspots, and enhancing tourism experiences (Gretzel, Sigala, et al.,

2015; Tripathy et al., 2018). Smart tourism destinations, due to their complexities and interrelations among the component of the destinations, represent a new way of understanding destinations and therefore substantiate the necessity of using a systematic approach for better understanding the complex issues (Femenia-Serra et al., 2019; Ivars-Baidal et al., 2017; Jovicic, 2019). The advent of the digital revolution has provided all stakeholders of tourism destinations with accessible information and facilitated the innovation process. Hence, to gain a competitive advantage, collaboration of digital business ecosystems with stakeholders, complemented with technological infrastructure, would be indispensable (R. Baggio & Del Chiappa, 2014; Pencarelli, 2019).

While there is no consensus over the definition of smart tourism destinations (Del Chiappa & Baggio, 2015), many scholars have suggested several definitions for smart destinations (Ávila, 2015; Boes et al., 2015; Buhalis & Amaranggana, 2013; Lamsfus et al., 2015). Up till now, one of the most frequently used definitions by SEGITTUR organization; therefore, the smart tourism destination is:

"An innovative space, accessible for all, established on a cutting edge technology infrastructure which guarantees sustainable development of the land, facilitates the interaction and integration of the visitor with the surroundings and increases the quality of their experience in the destination, as well as the quality of life of residents" (Ávila et al., 2015, p. 32).

Systems view to a smart tourism destination was used by Ivars-Baidal, et al. (2017) and Shafiee et al. (2019). Ivars-Baidal used a systems approach to evaluating the evolution of ICT in smart tourism destinations.

Shafiee et al. (2019) proposed a holistic model for smart tourism destinations by implementing grounded theory methodology. Lately, Cavalheiro et al. (2020) proposed a conceptualized a holistic framework of smart tourism destination development to enhance competitiveness and promote co-creation within a destination. The presented model as a strategic process tends to encompass approaches of sustainable development, citizen-centric, public-private engagement fo building a smarter tourism destination. Cavalheiro et al. (2020) devised their model into four layers, wherein 1) ground layer (tourism destination) refers to the competitive advantages gained though the formation of a tourism destination; 2) Layer one (smart ICT infrastructure) denotes the role of ICT as an empowering tool to promote citizen participation, create an interconnected ecosystem within the destination and support the entire tourist experience and all businesses; 3) Layer two (tourism application) illustrate the importance of adoption and usage of ICT in tourism destination where an integrated ICT ecosystem; 4) Layer three (smart tourism destination) as the final step of this process describes how ICT can construct a sustainable and competitive destination and ultimately promote public value creation within the host community.

4. Smart ecosystems in tourism

Ecosystems are intricate networks of businesses, socio-economic, and environmental subsystems, including all direct and indirect factors as both competitors and collaborators (Moore, 2006). Arguably, the attribute of modularity enables ecosystems to perform distinctively, yet be interdependent. Besides, ecosystems' inherent complexity describes it as a set of multilateral complementarities that links various parties together (Jacobides et al., 2018). Moreover, digital business ecosystems, as an extension of Moore's (2006) idea pivoting around digital technology as the dominant factor (Nachira, 2002), referring to a biological community of interacting organisms (R. Baggio & Del Chiappa, 2013). Thus, the digital business ecosystem is a networked system of multilateral players complemented

by technology to form a transparent and open environment (R. Baggio & Del Chiappa, 2013; Stanley & Briscoe, 2010). Cities, similarly, are complex ecosystems where a multitude of interests and stakeholders are involved, and are encompassing innovative and creative environment while striving to achieve a sustainable environment and better quality of life through collaboration with each other (Ahvenniemi et al., 2017; Capdevila & Zarlenga, 2015; De Guimarães et al., 2020). Several scholars considered cities in general and smart cities in particular organic systems comprising many subsystems, wherein the amalgam of ICT, ubiquitous access, knowledge networks, and applications coupled the interdependency among this complex components makes the system of systems smarter (Cavalheiro et al., 2020; Chourabi et al., 2012; Dirks et al., 2009).

Likewise, tourism destinations comprise various sectors and subsectors, which are interrelated and working simultaneously, consequently, resembling the complexity and interconnectedness of an ecosystem (R. Baggio, 2008; Femenia-Serra et al., 2019; Perfetto & Vargas-Sánchez, 2018). R. Baggio and Del Chiappa (2014) claim that the topic of digital business ecosystems in the field of tourism has been underrepresented and has mostly been a description of the interrelation between ICT and tourism rather than an approach to examining the complex behavior of tourism systems. Ecosystems mainly emphasize the holistic view rather than focusing on components of systems by recognizing how small changes can have substantial effects, encourages a focus on complex relationships, underlines dynamic change (Benckendorff et al., 2014; Gretzel, Werthner, et al., 2015). Hence, digital ecosystems are focusing on the interconnectedness among technological agents (devices, databases, programs, etc.) to enhance the dynamic information exchange within the system.

Since the tourism industry is highly dependent on ICT, smart tourism can be a pivotal change from traditional tourism to a more innovative and technology-centered tourism industry, which pushes the businesses towards adopting ICT in their systems (Gretzel, Sigala, et al., 2015). All the stakeholders, therefore, through an advanced infostructure provided by innovative technologies, form a dynamic network of interconnected actors within the tourism ecosystem wherein smart users can enhance their smart experiences and co-create with other stakeholders (Buhalis, 2019; Femenia-Serra et al., 2019). According to Porter and Heppelmann (2015); products are evolving into smart, connected devices that are increasingly embedded in broader systems; thus, reconstructing companies and competition. Smart destinations have provided visitors with new ways of mobility and tourism experiences through a mobile environment (Lamsfus et al., 2015). For instance, new digital technologies such as IoT, augmented reality (AR), artificial intelligence (AI), and wearable devices provide tourists with immersive experiences and enable them to capture and share their experiences (Pencarelli, 2019; Sedarati & Baktash, 2017; Tussyadiah, 2013). While the accessibility and affordability of technology do not necessarily guarantee the users' acceptance (Gretzel, Sigala, et al., 2015), the relevant application development could reinforce the users' perception of the functionality of technology. Nevertheless, it has been argued that to promote co-creation and enhance tourism experiences in a destination, establishing a collaborative ecosystem where a wide range of stakeholders, authorities, tourists, businesses, and government are involved is crucial (Pencarelli, 2019).

Additionally, scholars have proclaimed that digital ecosystems are complex adaptive systems with attributes such as self-organization & scalability and thought to solve complex dynamic problems where can be beneficial in addressing the sustainability of social, environmental, economic systems (Senyo et al., 2019; Stanley & Briscoe, 2010). Moreover, to achieve a better quality of life,

environmental preservation, economic growth, smart tourism destinations have to move towards the sustainability paradigm (Koo et al., 2016; Pencarelli, 2019). In another view, Höjer and Wangel (2014) propose the "smart sustainable cities" and argue that a city's sustainability is not necessarily dependant on the use of smart technologies; as such, ICT can be implemented for sustainable development purposes. However, they believe that the notion of sustainability is concealed within the definition of smart cities but can often be excluded. Besides, Neirotti et al. (2014) enumerate smart mobility, smart environment, and the smart economy as the prominent domains of smart city initiatives in recent studies. Subsequentley, Höjer and Wangel (2014) define a smart sustainable city based on the Brundtland report (1987) as a place supported by ICT, where people's present and future needs are met socially, environmentally, and economically. An attempt to carry a comprehensive review regarding various aspects and building blocks of smart tourism destinations and bearing the shaping factors of smart ecosystems furnished us with a better understanding to proposes a holistic model of smart tourism ecosystems formation in this study.

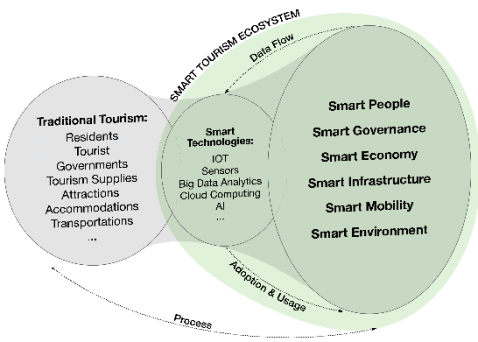

Figure 1. Smart Tourism Ecosystem Model

Figure 1. shows the smart tourism ecosystem model, which defines the process of it's formation, and presents the foundation criteria for developing and designing qualitative and quantitative models. Furthermore, smart technologies' role is encapsulated in the model as a catalyzer to generate interconnected systems of systems where the constant flow of information coupled with the analytical power of new technologies and intelligent systems will shape an iterative process of value co-creation.

5. Building a causal loop model

Modelling employs the techniques that allow both quantitative and a realistic representation of variables that are typically perceived to be qualitative. These are not merely hypothesized plausible futures but computed by simulating changes in strategy and the business environment (Georgantzas, 2003). System researcher will find tourism as a "black box", which means tourism as a system with its inputs and outputs, interactions among single subsystems. Key findings of the carried out literature on the complexity of smart cities and smart tourism destinations wherein building blocks and shaping factors of smart tourism ecosystems have been scrutinized, enabled us to employ systems thinking methodology to depict the existing interconnections and feedback structures within smart tourism destination ecosystems. Hence, the proposed model of smart destinations (fig.2), by using Vensim Software, serves as the premise for further developing our model on smart tourism ecosystems. The process of CLD development initially starts with structuring the problem wherein the scopes and boundaries of the study are identified. Afterward, key variables are identified, and the relationships among the variables are then illustrated.

As shown in Fig.2, the diagram can be described with three reinforcing loops as follows: First (+) feedback loop: smart people (+) influences in the same direction onto smart mobility, which (+) influences smart people). Second (+) feedback loop: smart people (+) influences in the same direction onto smart governance (+), which

influences upon smart infrastructure, smart mobility and back to smart people (+). Third feedback loop; smart economy influences smart environment and smart environment (+) influences smart economy.

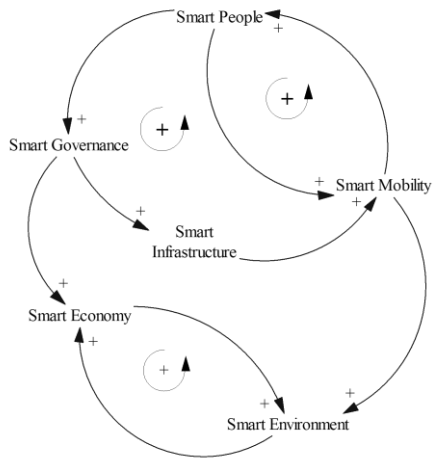

Figure 2. CLD Model of Smart Ecosystem's Founding Components

The presented reinforcing model (Fig. 2) is solely illustrated by the reinforcing feedback loops showing the growing action of smart destinations' building blocks. Therefore, no balancing loop has been depicted in this model since each building block has been extensively scrutinized in figure 3 (see Appendix 1), a causal loop model in a frame of systems approach using the systems thinking as a method.

6. Conceptual model's interpretation

The imperative shift from a traditional perspective to a novel approach by utilizing a set of artificial, numerical, and computer-based models necessitates a systemic and holistic approach for addressing complex problems. Wherefore, proper knowledge of the dynamic characteristics of the complex systems is essential for their management and governance (J. Baggio & Baggio, 2020; R. Baggio & Del Chiappa, 2016). As discussed earlier, looking into the cause and effect among the components of the system is a necessary step to understand a system's behavior while considering some effects are caused by the simultaneous consequences of different components in one system. By breaking down the whole system's structure into smaller segments and increasing the possibility of studying dynamic relationships among components of the system, systems thinking can be deemed as one of the practical tools for a modeler to have a holistic approach in analyzing models (Jere-Jakulin, 2017; P. Sedarati et al., 2018). Delving in the existing literature and extracting key components forming a smart tourism ecosystem allowed us to depict a bigger picture of the system of systems of tourism within a smart destination (Fig. 2) and further explore the key variables. The scrutiny of all building blocks of smart tourism ecosystems presented above and considering the previously mentioned literature, all the key variables have been elicited and illustrated in the CLD model (Fig. 3).

Smart infrastructures comprise a multitude of complex domains wherein smart technologies have shaped an accessible interconnected open platform through the actuation of innumerable embedded sensors in destinations' infrastructure, hence, fundamentally disrupted traditional infrastructures. The implications of such advancements increase the adoption and usage of smart technologies offering multiple smart solutions and experiences derived from big data analytics and AI (Putnik et al., 2015; Woetzel et al., 2018).

Planning, development, operation, and maintenance of destinations are costly, complex, and sluggish. Hence, the integration of new aspects such as transparency, employment of disruptive technological innovation, and participation in decision making draws the attention to the new term of smart governance. The investment in new technologies, real-time data analytics, participatory platforms, and assimilation of human and social capital results in a cost-

effective, well-managed and sustainable governance system that ultimately improves the quality of life of the citizens (Bifulco et al., 2016; De Guimarães et al., 2020).

Suffice to say that smart tourism destinations share the same smart cities' features wherein ICTs lay the foundation for a complex interconnected ecosystem trying to tackle the economic, social, and environmental challenges. Accordingly, improvement of the policies and regulations incrementally increases the administrative efficiency leading to more lucrative grounds for more investments and emergence of new businesses. Thus, permeating ICT to all economic activities offers an opportunity and facilitates the shift towards the circular economy by becoming more innovative, competitive, digital, and sustainable (Chourabi et al., 2012; Vinod Kumar & Dahiya, 2017).

Mobility, as one of the vital functions of tourism destinations, has a substantial impact stakeholders' quality of life. Smart mobility as a multifaceted issue can contribute to alleviation of fuel waste, pollution, environmental footprint reduction, supporting the traffic optimization and collecting citizens' (users) generated contents in real time regarding the quality of transport, livability of the cities, and ultimately improving the quality of life and reducing costs for all stakeholders (Banister, 2008; Benevolo et al., 2016).

The rapid population growth and perpetual excessive use of natural resources have brought about many imbalances, which entails efficient and effective systems to manage multiple infrastructures. Subsequently, promoting smartness can be deemed a viable and effective solution for managing the repercussions of overpopulation and tourist flow. Smart Environment lays a foundation for opting alternative energy sources, therefore, regulating consumption patterns and CO2 emission. Moreover, sensorizing the destination optimizes water sanitation, sewage, and leakage management, while enabling and efficient monitoring and recycling management system (Aletà et al., 2017; Vinod Kumar, 2020).

Improving the quality of life by integrating smart infrastructure into physical and social infrastructure is one of the main goals of smart cities. Therefore, an intricate network of applications delivering services to people, an interconnected network where all components of the systems interact, and a delicate foundation of sensors and devices for acquiring data. The smart services prevail in a multitude of subsectors in smart cities ranging from administration, education, public health, to safety, and many more. The emergence of IoT has transformed people's lifestyle and coined the term of "people as sensors". Smart people, as one of the main building blocks of smart cities, play an essential role in creating a destination image and contributing to destination's attractiveness while participating in monitoring and decision-making process by using smart devices (Choe & Fesenmaier, 2017; Nam & Pardo, 2011; Wilson et al., 2015).

7. Conclusion

The concept of sustainable smart tourism ecosystems is an amalgam of several complex concepts ranging from smart cities, smart tourism, sustainability, and ecosystems heavily interrelated and forming a complex system of systems. Thus, smart tourism ecosystems are a networked system of multilateral players complemented by ICT, where stakeholders are encouraged to move towards an innovative and sustainable environment and achieve a better quality of life through collaboration and networking. The sustainability of tourism destinations is not necessarily dependent on ICTs implementation, and similarly, the implication of ICTs can have ramifications rather than contributions. However, putting more emphasis on combining these two

concepts requires applying a holistic view to raise awareness, create a joint vision, and a new framework to develop a panacea to address strategic issues related to sustainable smart tourism ecosystems holistically.

Digital ecosystems as complex adaptive systems with attributes such as self-organization & scalability and thought to solve complex dynamic problems have gradually become an indispensable context for fundamentally transforming the entire tourism industry through the smart solutions offered to address the social, economic, and environmental sustainability of the tourism systems. Information and communication technologies have disruptively transformed traditional tourism systems and made it smarter. Even though studies on both smart tourism and sustainability concepts are still ongoing, there is room for further improvement of causal and contextual awareness in these regards; many scholars have contributed to these topics through different lenses and perspectives. Consequently, bearing the previously presented literature, it can be concluded that migrating to a systemic and holistic approach can be facilitated through smart technologies. Moreover, this approach further applies to the tourism industry as a complex system where systems thinking has proven to be a viable approach for better understanding the complexities of tourism industries regarding the economy, environment, governance, people, and others, and interrelationships among several systems in smart destinations. Nevertheless, research on the role of sustainability within smart tourism ecosystems, more particularly, the interrelations and cause and effects among complex building blocks of smart tourism ecosystems, yet to be thoroughly scrutinized from a holistic perspective.

The systems thinking approach offers alternative tools and ways of carefully observing and depicting the world, which affects the policy planning and decision-making process. Smart tourism research can take advantage of this approach to understand the complex interrelationships, underlying values, and stakeholders' perceptions to gain a holistic preceptive, which allows the intervention within the ecosystem and ultimately ensuring the prevalence of sustainable tourism development. Therefore, to elucidate the problem, this paper first has discussed in detail the interconnection and foundation of smart tourism ecosystems by proposing a general conceptual model describing the transformation of traditional tourism through ICTs to become smart tourism ecosystems. Second, by explicating each building blocks of smart tourism ecosystems and using systems thinking method and modeling to break down the complex system of smart tourism's roles and components. According to the model illustrated in this paper, it can be concluded that to ensure an equilibrium, ICTs adoption can empower residents/tourists' experiences by allowing seamless co-creation and involvement with the smart ecosystems; unequivocally, it can be concluded that smart governance plays a significant role in this process. The causal loop diagram proposed in this study considers sustainability as one of the main concerns and trying to shed some light on intricate networks of businesses, socio-economic, and environmental subsystems in smart tourism destinations that are performing distinctively, yet interdependent.

The CLD model proposed in this paper represents smart tourism ecosystems describing the implication of ICTs and considering sustainability as intrinsic concerns for this study. This CLD model is likely to be of interest to academics and practitioners to augment their understanding of an interconnected system of systems. More importantly, to fathom the prerequisites for developing and implementing sustainable strategies regarding smart tourism destination. Smart solutions, thus, are improving and optimizing the smart tourism destinations' core systems' performance by utilizing instrumented, interconnected, and

intelligent capabilities of smart destinations. Wherefore, these solutions should be built upon strategies developed through citizen-centric, people-centric, or human-centered approaches. The model acknowledges the significant role of smart people in multitude aspects of smart destinations, such as a) ubiquitous access and transparency enable ICT based governments with more robust participatory policies for involving people in the decision-making process and strategic planning; b) smart people/tourists and businesses activities can be improved due to their dependency on the disruptive impact of smart infrastructure on transportation, service industry, and communication systems; c) pervasiveness and cost efficiency of smart technologies realize the instrumentation of smart destinations for data gathering; d) IoT enable seamless interconnections among people and systems, wherein cloud computing will treat data to generate predictive insights for decision-makers and residents/tourists, consequently, improving the residents' quality of life and tourists' experience.

Sensorizing the destination will lead to the generation of the massive amount of data coupled with AI and big data analytics, allow the smart infrastructure to offer smart solutions to different subsystems, and eventually improve the quality of life and experience of smart people. For instance, smart mobility: with real-time navigations, smart parking, ride-sharing platforms, smart environment: with smart grids, waste management, water/energy tracking systems. However, smart infrastructures generate, capture, and analyze massive amounts of public and private data, meaning that access to abundant real-time data sources raises privacy concerns, limiting governments to exploit smart technologies' full potential, concurrently, an incentive to move towards transparency and openness. Future research should focus on using the system dynamics approach to convert the qualitative model presented in this study to quantitative modeling and simulation and put more emphasis on human-machine interaction, AI, big data analysis, and ecosystem business dynamics. An important area of investigation for future research would be to run various scenarios and empirically test and validate the results. Moreover, as the CLD model has been built as a generic model, it does not address any specific geographical context. Therefore, the model is malleable and can be adjusted by adding or deleting causal loops or developing a system dynamics model using specific parameters to examine it further.

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Appendix 1.

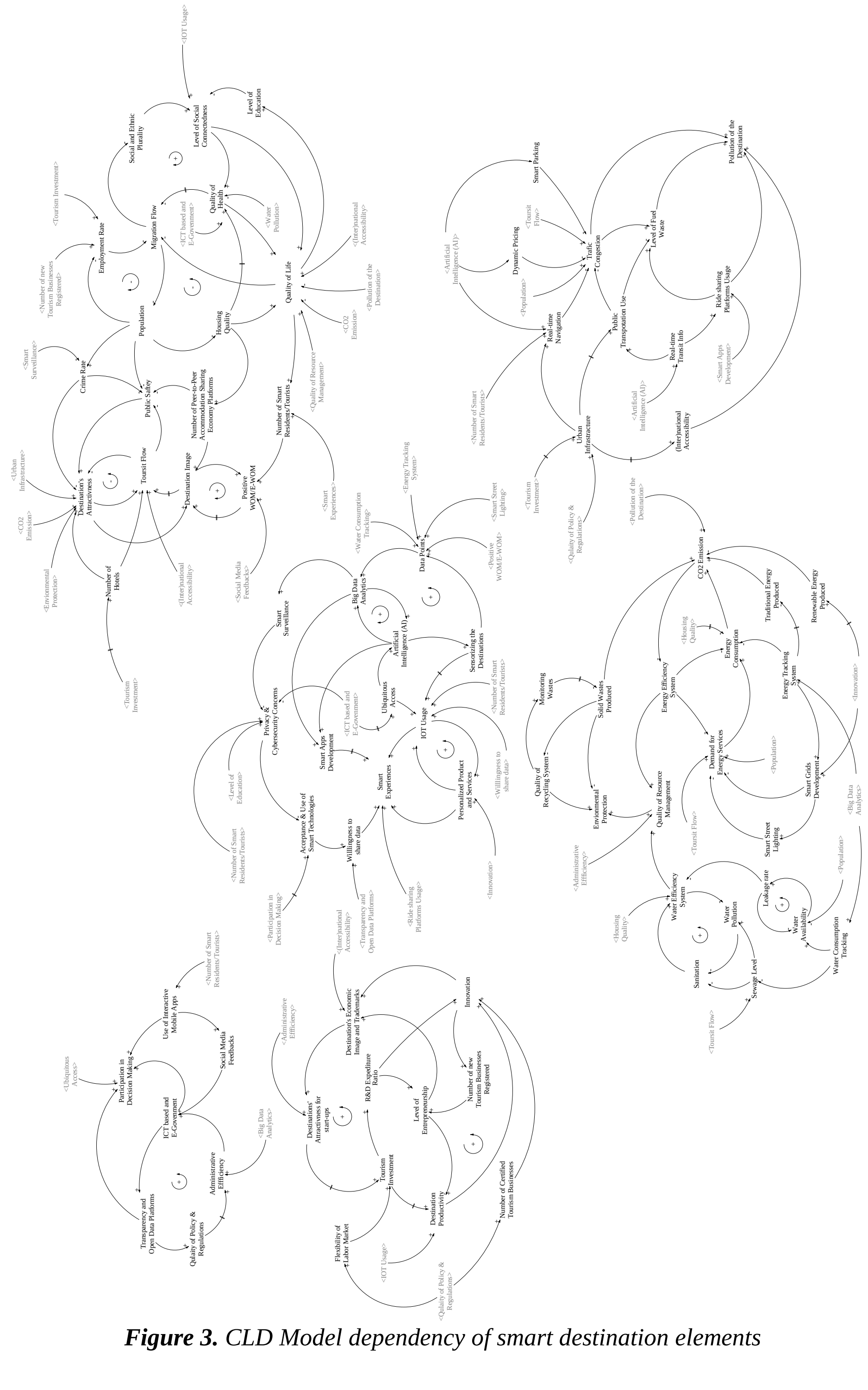
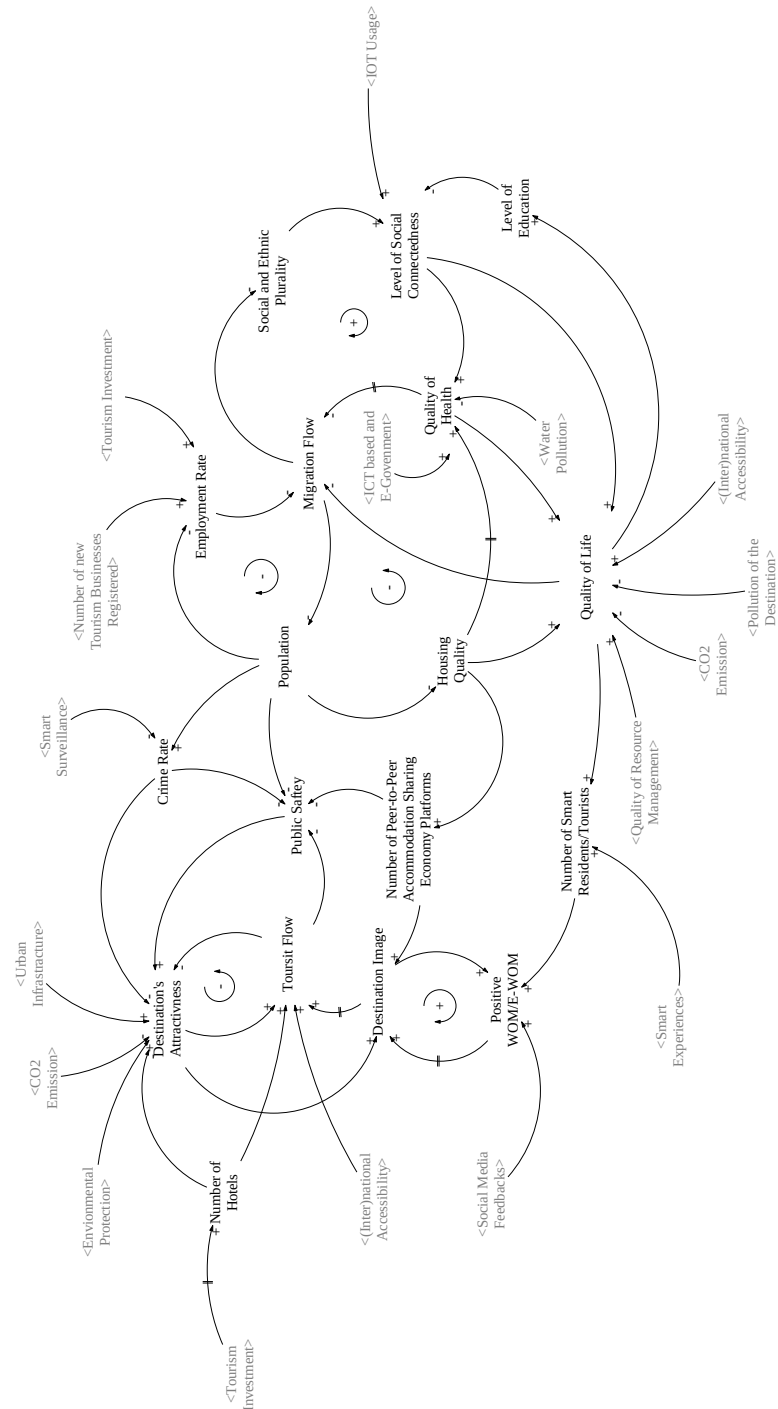


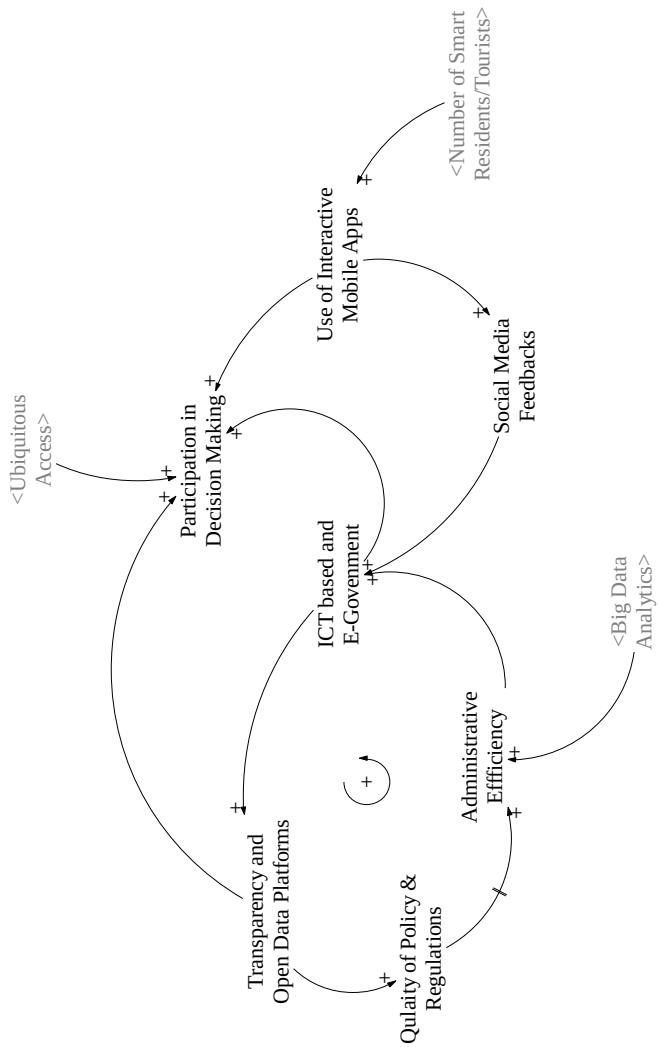
Figure 3. *CLD Model dependency of smart destination elements*

Appendix 2. Components of the model

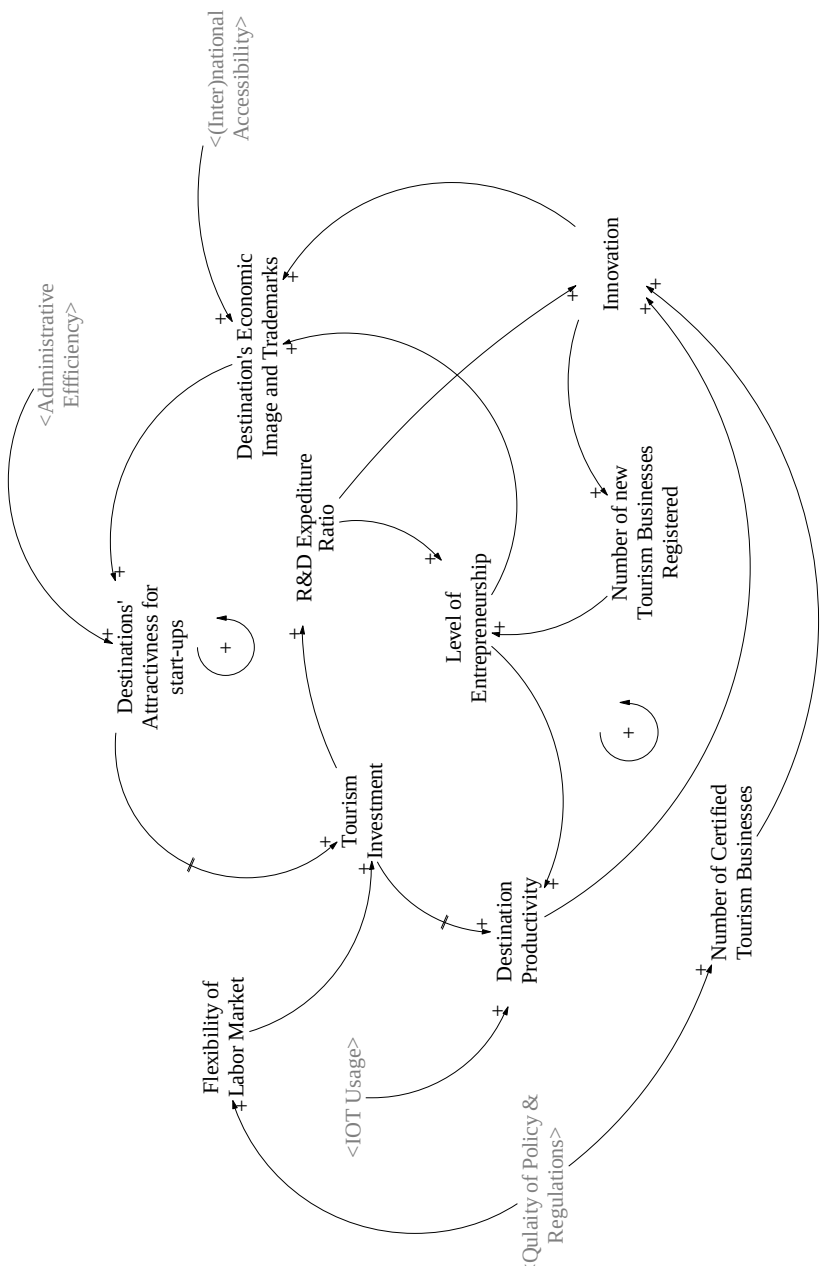
Smart people



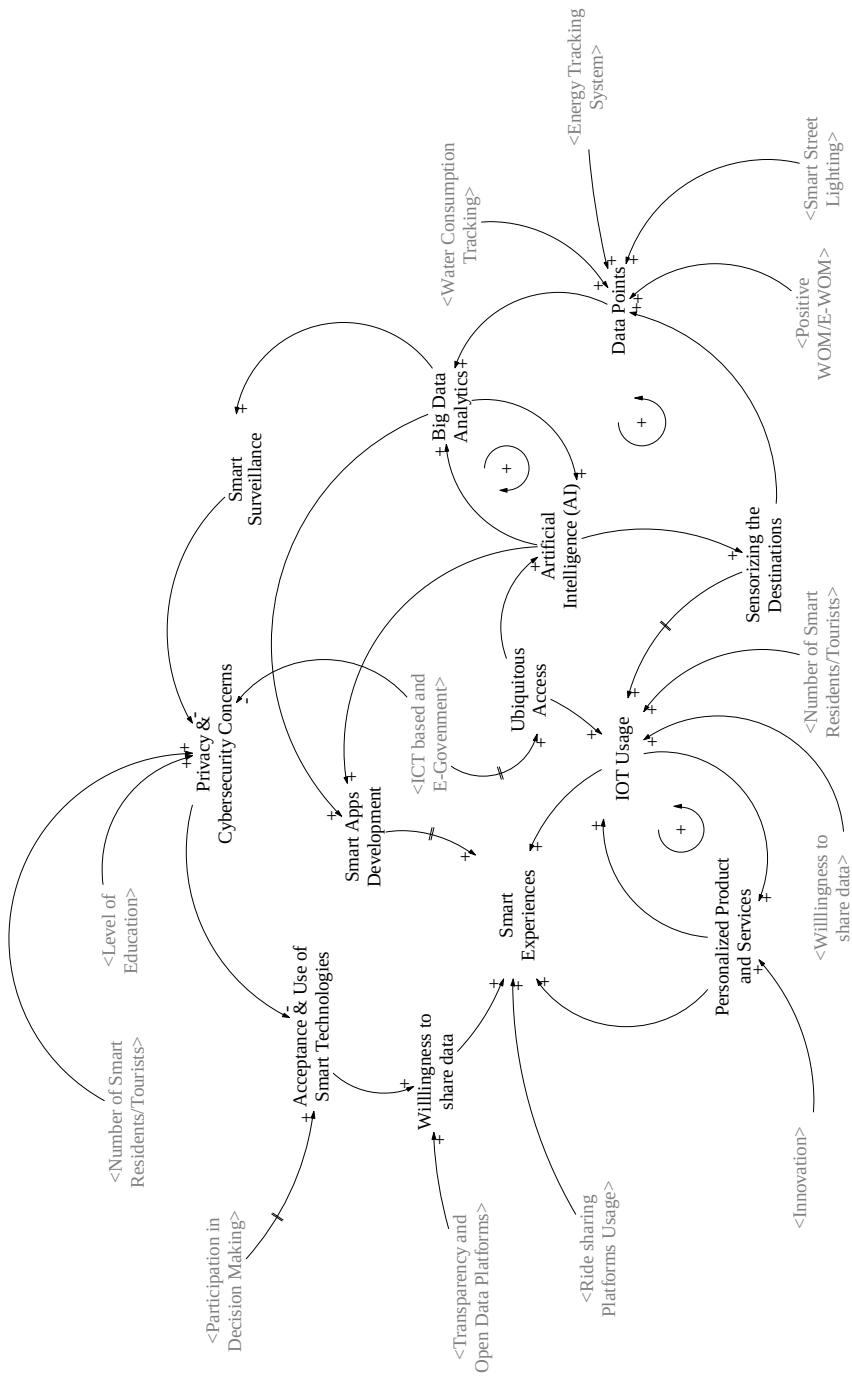
Smart governance



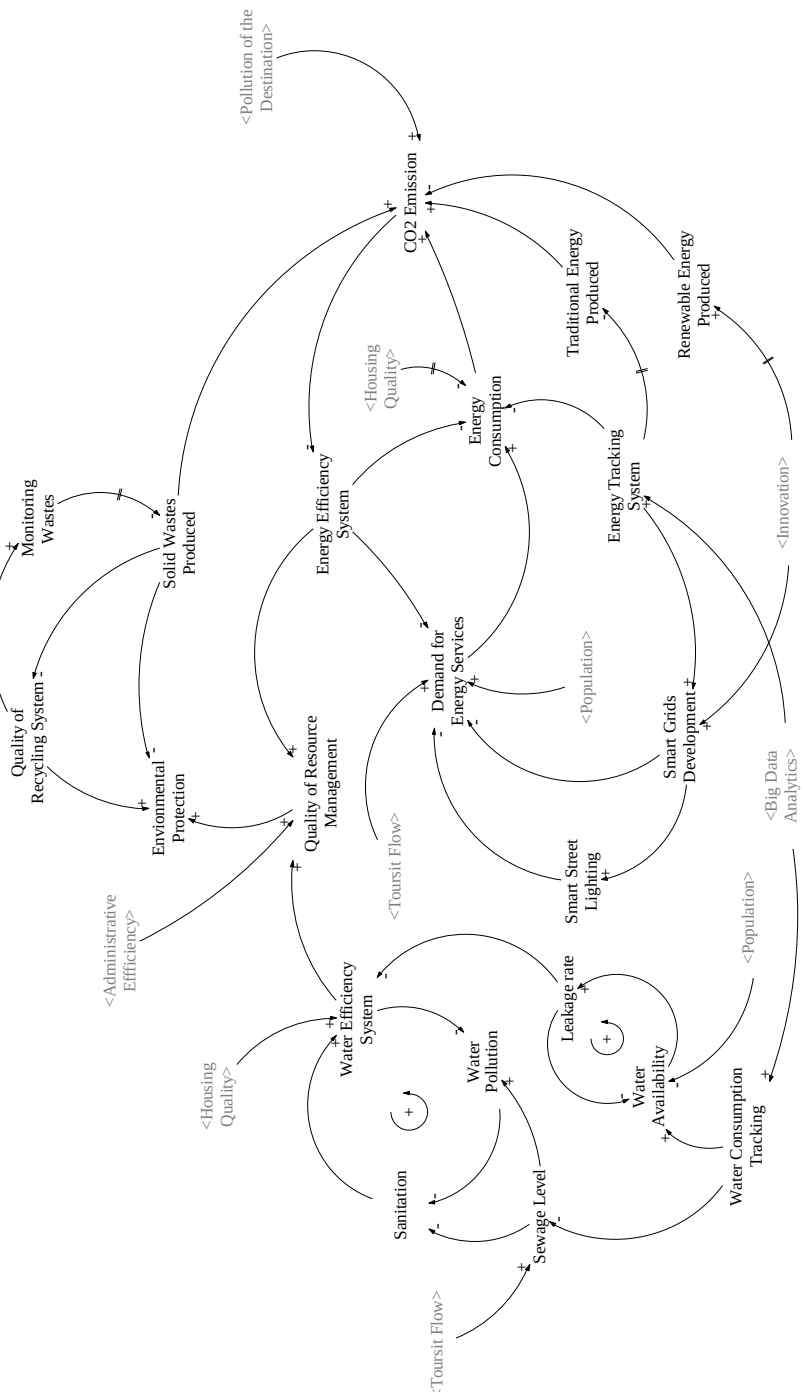
Smart economy



Smart infrastructure



Smart environment



Smart Mobility