The complexity of decision-making processes and IoT adoption in accommodation SMEs

Published on Journal of Business Research

FULL TEXT (DOI): https://doi.org/10.1016/j.jbusres.2021.01.010

Nikolaos Pappas
Associate Professor
Department of Hospitality, Events, Aviation and Tourism
University of Sunderland, United Kingdom
Email: nikolaos.pappas@sunderland.ac.uk
ORCID: 0000-0002-8838-017X

Andrea Caputo (*Corresponding author*)
Associate Professor
Department of Management
University of Trento, Italy
&
Department of Management
University of Lincoln, United Kingdom
Email: andrea.caputo@unitn.it
ORCID: 0000-0003-2498-182X

Massimiliano M. Pellegrini
Associate Professor
Department of Management and Law
University of Rome "Tor Vergata", Italy
Email: massimiliano.pellegrini@uniroma2.it
ORCID: 0000-0002-5722-2988

Giacomo Marzi
Lecturer
Department of Management
University of Lincoln, United Kingdom
gmarzi@lincoln.ac.uk
ORCID: 0000-0002-8769-2462

Eleni Michopoulou
Associate Professor
College of Business, Law and Social Sciences
University of Derby, United Kingdom
Email: e.michopoulou@derby.ac.uk
ORCID: 0000-0002-1857-4462

Abstract
The current competitive scenario is fast-moving toward an integration of sophisticated technological innovations, i.e. smart solutions for hospitality, in particular the accommodation industry. Internet of Things (IoT) technologies are able to connect and let communicate different devices to craft a personalized customer experience. Given the undeniable impact for the hospitality sector, the decisions about adopting smart solutions are not always linear: benefits and limitations co-exist and need to be weighed against each other. By adopting fsQCA, this paper compares several decision-making factors that may influence the willingness to adopt IoT, surveying owners/managers in the Greek accommodation industry. Results show four types of decision-making: (i) rational, a weighted evaluation of risks and opportunities; (ii) enthusiast, mostly highlighting benefits to gain a competitive advantage; (iii) cautious, emphasizing risks and barriers to innovate; and (iv) futurist, a consideration of future technological necessities related to the increasing digitalization.

Keywords: IoT; smart solutions; hospitality; accommodation; tourism; decision-making; fuzzy-set QCA.

1. Introduction

The tourism sector has been heavily affected by the digital transformation and diffusion of smart technologies (Law et al., 2014; Pizam, 2017; Mariani, 2020). Specifically, the smart tourism paradigm creates opportunities to improve efficiency, visibility, traceability, and co-creation (Koo et al., 2017). Companies adopting such paradigm rely on environments in which human-machine interactions are facilitated thanks to large bulks of data autonomously shared in a complex network of machine-machine interactions (Caputo et al., 2016; Fakahr-Manesh et al., 2020; Guinard et al., 2010; Trequattrini et al. 2016). In this context, the Internet of Things (IoT) allows objects and devices to autonomously communicate and learn behaviors. Smart solutions based on IoT can be used to improve customer experiences (Almobaideen et al., 2018; Femenia-Serra et al., 2019) by aligning customers' preferences to a customized experience that better meets expectations (Centobelli and Ndou, 2019; Law et al., 2014; Lin, 2011; Pizam, 2017). Such solutions can benefit the enjoyment of the experience by integrating products and services (Gretzel et al., 2015), by accruing familiarity with the travel and the destination, offering ad-hoc access to information and inter-modular transportation (Buhalis and Amaranggana, 2015; Buhalis et al., 2019); or by molding the physical environment around customers (Nolich et al., 2019).

In the accommodation industry, however, the decision to adopt such smart solutions is not free from limitations and risks in their implementation. Customers may feel not competent in dealing with the technological systems (Bogicevic et al., 2017), uncomfortable in using the technology, and having the perception of losing control over their data (Ho et al., 2017; Buhalis and Amaranggana, 2015). Thus, decisions related to the adoption of such solutions need to be properly weighted.
The general approach to research these topics has mostly been based on normative and theoretical contributions (Gretzel et al., 2015), qualitative case studies (Nolich et al., 2019), or rather linear statistical approach (Bogicevic et al., 2017); nevertheless, understanding a complex decision-making process of balancing benefits and challenges of smart technology adoption in the accommodation industry requires a more sophisticated, non-linear investigation. Hence, the present study aims at improving our knowledge of decision-making about IoT and smart solutions adoption in the accommodation industry by applying complexity theory and fuzzy logic to develop a comprehensive explanatory framework. The analysis is performed on a dataset of 528 managers/owners of Greek accommodation SMEs, through a *fuzzy-set Qualitative Comparative Analysis* (fsQCA). The results confirm the better accuracy of fuzzy analyses over linear models (Pappas, 2019a).

The context of the study is the accommodation industry in Greece, where tourism is a key element of the country's economic activity, contributing more than a fifth of its overall Gross Domestic Product (GDP) (World Data Atlas, 2020). The country hosts more than 30 million tourists per year (World Bank, 2020), making Greece as one of the most popular destination worldwide, whilst creating a substantial demand for accommodation establishments. In 2018, to accommodate this amount of visitors Greece had about 38,000 accommodation establishments, most of them being small and medium enterprises (SMEs) (Statista, 2020). Changing market dynamics, business size and fragmentation of the Greek accommodation industry are among the contributing factors to the need for embracing new technologies in order to further strengthen competitiveness (Kozak and Buhalis, 2019; Pappas, 2015; 2018). However, the literature is still scarce in terms of the examination of decision-making processes about technological adaptation, let it alone IoT in the accommodation industry.

Thus the aim of this research is to examine the willingness of the Greek accommodation providers to adopt IoT. To do so, the paper evaluates elements of the decision-making process; specifically perceived benefits, risks, barriers, competition, innovation and the technology competence of the examined companies. This paper contributes theoretically by validating the assumption that decision-making processes about the adoption of smart tourism and IoT is a complex matter that needs to be approached configurationally. By considering different factors affecting such decisions, and how they are weighed against each other, the paper unveils four types of decision-making. Methodologically, the study further confirms the suitability of nonlinear (asymmetric) research in service industries (Pappas 2018, 2019b). Finally, at a practical level, the generated solutions offer hints to accommodation entrepreneurs and managers about most relevant combinations of factors that should receive a careful attention when the decision of adopting IoT and smart solutions is evaluated.

2 Literature review and tenant postulation

2.1. Smart solutions, IoT and smart tourist accommodation

Smart tourism is global phenomenon that is shaping the whole competitive arena (Law et al., 2014; Wang et al., 2016). For this reason, it is important to provide explanation about what technologies and solutions are at the base of this evolution and related benefits but also risks in implementing such solutions.

Smart tourism refers to a rather blurred concept that encompassed a broad array of interventions related to technological innovations (Buhalis and Amaranggana, 2015; Gretzel et al., 2015). Examples of smart solutions range from the trivial creation of a Wi-Fi network accessible at the location site to complex architectural environments in which consumers' preferences are used to mold the touristic experience (Almobaideen et al., 2018; Bogicevic et al., 2017; Femenia-Serra et al., 2019).

Such technological advancements in tourism are the results of disruptive changes brought forward by what has been named fourth revolution or industry 4.0. Generally speaking, this concept refers to a paradigm where virtual domains perfectly work in tune with physical ones and thus establishing a productive system in which connected machineries to act as a collaborative communities capable of making decisions in real time through Internet-based technologies (Bauer et al., 2015; Brettel et al., 2015). In more practical sense, industry 4.0 occurs when several technological advancements and paradigms work symbiotically; for a brief review of its elements, we can refer to cyber-physical systems (CPSs), Big data, Artificial intelligence (AI), and IoT. These elements despite being devoted to different functions, as premised, should also be integrated. A CPS is the overall environment where physical, virtual, and computational processes are integrated, so that modifications in the 'real world' are enacted by a virtual input (Bauer et al., 2014). An example could be a smart building, where several installations and power grids can be controlled remotely or directly self-controlled (Fakhar-Manesh et al., 2020). This environment, especially if autonomously run, necessitates the handling of an enormous amount of data created and used by the embedded sensors, i.e. big data (Kang et al., 2016). This data can be actively used only if the machines are able to interpret them and thus sophisticated algorithms and deep learning cycles are in place, i.e. AI (Bauer et al., 2014; Kang et al., 2016).

However, at the very core of this infrastructure lies the ability of the interconnected parts or objects to communicate (Brettel et al., 2015). Since this communication usually happens through internet and internet-based protocols these technologies are named IoT. Thanks to IoT, objects able to produce data from their functioning and surrounding environments, share them with other devices autonomously (Caputo et al., 2016). Specific protocols, such as the Radio Frequency Identification (RFID), allow the interface of different devices and objects, and thus the sharing of located information across the network (Guinard et al., 2010). Stretching further these considerations, most of the smart solutions are possible in reason of IoT-based smart technologies and this is why we decided to inquire specifically the decision making related to the adoption of IoT as one of most relevant solutions.

The implementation of IoT-based smart technologies in hospitality can generate a positive impact on the overall touristic sector (Pizam, 2017; Mariani, 2020). From a business point of view, the impact can be even more considerable for the accommodation industry in terms of customers' perceptions and operative efficiency (Gretzel et al., 2015).

The use of IoT-based smart technologies can help tourists to reduce the challenges experienced in dealing with unfamiliar environments outside the safety of one's surroundings (Buhalis et al. 2019; Nolich et al., 2019). In conjunction with the whole tourism ecosystem, customers' devices can communicate offers and events for a specific location or being used to register preferences from which infer behaviors that can be anticipated (Centobelli and Ndou, 2019). However, customers unfamiliar with smart technologies can feel unease in accessing an already foreign environment that is technologically advanced and automated (Střelák et al., 2016). Furthermore, concerns are raising about the need of control over personal data and privacy violations (Ho et al., 2017; Ozturk et al., 2017). Also millennials, despite their technological savviness, expressed serious concerns about data protection and sharing (Femenia-Serra et al., 2019). Thus, tourists put in front of a smart environments may withdraw from engaging with the whole experience (Buhalis and Amaranggana, 2015). For these reasons, the appeal to invest in smart technologies can be limited if these elements are not valued from customers and if the integrative front-office services do not create new significant value (Chen et al., 2017).

There are also several operational benefits in adopting IoT-based smart solutions. Similarly to other industries, IoT can lead, for example, to waste reduction and energy efficiency (Zhang et al., 2017), or even the optimization of the parking spaces (Mishra et al., 2019). The operative side of a tourist accommodation can also benefit from the data produced by a series of IoT appliances such as smart lights, smart water meters, and smart heating systems. In combination with Big Data and Artificial Intelligence programs, these data can help to gain information and intelligence regarding customers' preferences even without their intervention and, at the same time, to optimize the operations costs by reducing inefficiencies (Inanc–Demir and Kozak, 2019; Trequattrini et al. 2016). Therefore, the emergence of smart environments and IoT technologies seem able to redefine business models to develop and sustain competitive advantage (Wang et al., 2016; Centobelli and Ndou, 2019; Trequattrini et al. 2016).

For what premised, it is clear that implementing IoT-based smart technologies requires balancing the benefits and challenges against the needed economic investment (Gretzel et al., 2015). Sophisticated solutions require a strong interaction between virtual and physical environments with the instalment of smart appliances and sensors, condition that can naturally increase implementation expenses (Almobaideen et al., 2018; Lin, 2011; Nolich et al., 2018). This investment will be even larger if the organizational and technological bases of the company are not solid nor ready for sophisticated innovations (Ho et al., 2017; Saarikko et al., 2017;).

2.2. The chaordic perspective

A delicate decision-making process of adopting IoT-based smart solutions may require a sophisticated approach of inquiry. To such a purpose, we adopt the lens of the theory of chaos. In brief, the theory of chaos was first introduced in 1963 (Lawrence, Feng & Huang, 2003). It indicates that organizational action and structure are capable to influence both the environment and the company (Levy, 1994), whilst it examines the way that chaos and order occur and ultimately lead to changes (Farazmand, 2003) even if it is almost impossible to provide standardized answers due to the variation of organizational and human capacities (Silvestre et al., 2018). The theory of complexity has evolved from the theory of chaos (Pappas, 2019a) and suggests that we cannot explain via cause and effect relationships several aspects around us, since specific effects may appear from random interactions, lacking any kind of deterministic cause (Kretzschmar 2015). The concept of a 'chaordic system' derives from the strong relationship between chaos and complexity (Fitzgerald and Van-Eijnatten, 2002), taking its name from the term 'chaord', which is an amalgamation of the words chaos and order (Van Eijnatten et al., 2007). Such systems include a dynamic and complex connection set between elements that form a unified whole, with unpredictable (chaotic) behaviour, whilst simultaneously including specific patterns (order) (Olmedo, 2011).

2.3. Complexity in a smart tourism context and study of the tenants

There is still a scarce attention to the main elements that may drive the decision of investing consistent financial and organizational resources to include IoT-based smart solutions in the tourist reception offer and back-office operations (Bogicevic et al., 2017).

Think of a hotel targeting the elderly tourist segment and the nexus of factors affecting the decision-making around the adoption of IoT-based smart solutions. Due to the possible difficulties in dealing with technological innovations of the generalized elderly population, such customers may perceive little, if any, value in smart accommodation solutions. Furthermore, the investment to fill the gap between the current traditional offer and the minimum requirements for adopting smart solutions can be large.

The operational mode of the accommodation, annual or seasonal, is an important factor. Seasonal accommodations may find the level of investment to adopt IoT too high, risking to capitalize most of future additional earnings. This may further discourage innovations. However, an accommodation that overcomes the technological resistances of its customers could significantly improve their experience and thus their satisfaction and loyalty. IoT allows for more control over the physical surroundings, improving the servicescape and the co-created personalized experiences (Buhalis and Amaranggana, 2015; Roy et al., 2019). A smart servicescape through smart wearable devices allows for the possibility of a continuous monitoring activity, opening up avenues in the health and lifestyle tourism (Pizam, 2017; Almobaideen et al., 2018). Considering the aging of the population in developed economies, this customer segment will grow and smart solutions may help first-movers to gain a sensible competitive advantage.

From this example, we may infer that benefits of IoT can offset costs and barriers in implementation. However, a linear logic may fail to fully address the complexity of the problem. The willingness of managers to adopt IoT, either positive or negative, can result from a decision making-process that evaluates the several factors weighed against each other rather than a simple causal logic. The same factor may lead to different outcomes due to the occurrence or intensity of other conditions. Thus, despite the importance of identifying a set of influencing factors, the analysis of their configuration is the key strategy to understand the proper response to a complex touristic decision (Pappas, 2019a). Such condition forces to replace the traditional statistical hypotheses development to a configurational analysis, with the creation of 'tenets' or testable precepts (Wu et al., 2014). The set of tenets should be large enough to grasp the order of conditions related to the complexity at hand (Pappas, 2018).

This specific study examines the presence or absence (binary state) of the willingness to adopt IoT technologies in a touristic accommodation by the key decision-maker, i.e. the owner or manager. Along with the operational mode of the accommodation business (annual or seasonal), it is possible to summarize six relevant influencing factors: perceived benefits, perceived risks, perceived barriers, competition, innovation, technology competence.

Hence, this study formulates six tenets (Ti) and their related confirmation criteria (Ci) (Pappas, 2019a).

T1: The same attribute (factor) can determine a different decision depending on its configurational structure/interaction with the others.

C1. All six simple attributes should appear at least in one sufficient configurational solution, i.e. generated solution.

T2: Recipe principle: if two or more simple attributes create a complex configuration, higher scores will be consistently assigned to this generated solution.

C2. At least two out of the six simple attributes should appear in each generated solution.

T3: Complex interactions/configurations may affect the willingness of adopting IoT technologies.

C3. Each sufficient generated solution should provide a different interaction among simple attributes.

T4: Within different combinations, the simple attributes can either positively or negatively influence the willingness to adopt IoT.

C4. None of the simple attribute should appear in all generated solutions.

T5: Equifinality principle: A sufficient configurational solution, thus the presence of a willingness to adopt IoT, is not necessary the result of higher outcome scores for the simple conditions.

C5. fsQCA should provide a minimum of two generated solutions for describing the patterns of the willingness to adopt IoT.

T6: Although the outcomes scores are high, such a given recipe is not relevant for all cases, thus it cannot stimulate the willingness to adopt IoT in all cases.

C6. There should be no generated solutions that have a coverage in all cases.

3. Methods

3.1. Sample and measures

The research is based on a nationwide survey. Questionnaires were sent via email to Greek accommodation managers/owners during summertime 2019. Due to this data collection method, the response rate was expected to be low. Thus, approximately 5000 emails were sent. Greek Travel Pages (www.gtp.gr) was used as a source of the email addresses. In total 528 usable questionnaires were collected (Statistical error: 4.26 percent; Level of confidence: 95.74 percent). For missing data handling listwise deletion was adopted (exclusion of the entire record from the analysis), since this is considered as the least problematic method (Allison, 2001).

The questionnaire consists of 42 Likert scale statements (1 strongly disagree / 5 strongly agree). These statements are included in seven different constructs, and all of them have been adopted from previous research. More specifically, the statements concerning perceived benefits (nine statements) and perceived barriers (eight statements) have been adapted from the study of Tan et al. (2009). The five items examining perceived risks have been taken from the studies of Cocosila and Trabelsi (2016), and Ho et al. (2017). The four statements included in competition construct and the six items in technology competence have been adopted from Wang et al. (2016). The five innovation items have been taken from Divisekera and Nguyen (2018). Finally, the willingness to adopt IoT (five statements) has taken under consideration the studies of Gao and Bai (2014), Ozturk et al. (2017), and Park et al. (2017). Moreover, one question was examining the operational mode (annual; seasonal) of the accommodation establishments, and one more question (as an exclusion factor) was included in the questionnaire in order to ensure that the respondents were owners/managers of the respective firms. A linear presentation of the proposed model is illustrated in Figure 1.

The research has analyzed the collected data by using fuzzy-set Qualitative Comparative Analysis (fsQCA), in an attempt to encapsulate the complexity essence. fsQCA evaluates the relationships that can formulate the interesting outcome of any combination of binary sets created from its predictors (Longest and Vaisey, 2008). It is considered as a mixed-method technique since it embeds quantitative empirical testing (Longest and Vaisey, 2008) and inductive qualitative reasoning generated by case analysis (Ragin, 2000). It handles logical complexity by taking under consideration that alternate combinations of characteristics can generate different results when they are combined with different conditions and/or events in an appropriate manner (Kent & Argouslidis, 2005). Negates sets (absence or presence of a given condition) are also examined. Following the study of Skarmeas, Leonidou and Saridakis (2014), the calculation of the membership score in a negated set is made by taking from the original fuzzy set one minus the membership score of the examined case.

Please insert here Figure 1: The proposed model.

According to Ordanini, Parasuraman and Rubera (2014), in the set theory, a sub-relation's consistency with fuzzy measures is generated when the scores of membership in a causal set of attributes are equal or systematically less than the scores of membership in the outcome set. As a result, the calculation of consistency is:

$$Consistency\left(X_i \le Y_i\right) = \sum_i \left[\min\left(X_i ; Y_i\right)\right] / \sum_i (X_i)$$

where, for owners/managers *i*, X_i is the score of membership in the *X*. Following the same study, Y_i and configuration are the scores of membership in the outcome condition, whilst coverage embeds the assessment of the empirical importance of the generated solutions. Thus, the calculation of coverage is:

$$Coverage\left(X_i \le Y_i\right) = \sum_i \left[\min\left(X_i ; Y_i\right)\right] / \sum_i (Y_i)$$

The metric of asymmetric consistency is analogous to the metric of symmetric correlation, and the metric of asymmetric coverage is analogous to the determination of the symmetric coefficient. Woodside, 2014). When a generated solution is between .27 and .75, and has a consistency above .74 it is considered informative and acceptable (Skarmeas et al., 2014). Furthermore, the score of membership of a causal recipe (complex antecedent condition) is defined as the minimum of the scores of membership of the intersecting simple fuzzy-set causal conditions they include the examined recipe (Woodside and Zhang, 2013). In the correlation matrix, when all coefficients are less than .6, a general asymmetry exists among variables in the respective relationships (Skarmeas et al., 2014), and the causal conditions generated by alternative combinations are likely to lead to the same condition of outcome (Woodside, 2013). As it is showcased in Table 1, all coefficients are less than .6, showcasing the study's general asymmetry. Through the use of fsQCA, this study evaluates the way Greek accommodation providers perceive the potential of the Internet of Things (seventh construct) in their business by focusing on causal recipes that lead to high scores of membership in the other six constructs. The study is based on a non-linear analysis in order to describe the combined relationships and to identify asymmetric relationships.

Please insert here Table 1: Correlation matrix

Table 2 instead presents the results of the descriptive statistics.

Please insert here Table 2: Descriptive statistics

4. Results

As the present research includes 528 Greek accommodation institutions, Table 3 shows the sample divided by operational mode.

Please insert here Table 3: Profile of enterprises

Table 4 describes the grouping variables named "f_" for the various construct used in the fuzzy set model. The symbol "*" has been used for separating the constructs and an indication of their inclusion in model evaluation. The symbol "~" has been used to indicate the excluded construct.

Please insert here Table 4: Complex solutions for the Internet of Things

The results coming from fsQCA comprise four complex solutions, as highlighted in Table 4. Based on the emergent findings, S1, the first sufficient configuration (f_om*f_pb*f_pr*f_pba*~f_c*~f_i*~f_tc), suggests that the inclusion of the grouping variable operational mode (f_om) together with the perception variables related to benefits (f_pb), risks (f_pr), and barriers (f_pba) is able to produce a risk-evaluation approach for IoT potential adopters. The first solution appears to have the highest consistency (0.868) of all four solutions, with 0.430 coverage. S2, the second solution (f_om*~f_pb*~f_pr*~f_pba*f_c*f_i*~f_tc), shows that the grouping variable (f_om) together with the competition-related variables (competition, f_c; innovation, f_i) is able to produce a competition-based approach with a high consistency (0.842) and the highest cover among the four solutions (0.459). S3, the third solution (~f_om*~f_pb*f_pr*f_pba*f_c*~f_i*f_tc), which excludes the grouping variable, comprise the possible drawbacks associated with IoT adoption with specific attention to risks (f_pr), barriers (f_pba), competitive issues (f_c), and the required technological competence (f_c). S3, the third solution shows good consistency (0.810) and a satisfactory level of coverage (0.398). Finally, S4, the fourth solution (f_om*f_pb*~f_pr*~f_pba*~f_c*f_i*~f_tc), introduces the grouping variable (f_om) again together with perceived benefits (f_pb) and innovation (f_i) showing a process aimed to encompass the future necessities of the business in association with IoT. This final solution has an acceptable consistency (0.805) and a good level of coverage (0.414). Overall, the coverage is good (0.426) and the solution consistency high (0.829). According to methodological references (Skarmeas et al., 2014), this result indicates a satisfactory and informative solution that permits to provide a series of practical and methodological implication.

5. Discussion and Implications

The attention paid to the adoption of IoT by the tourism sector is still scarce and with possible contrasting evidence. The results of this study offer a more precise picture of decision-making in the accommodation industry, identifying several influencing drivers when it comes to service innovation via IoT-based smart solutions. These drivers are interconnected together in a nexus of decisions; one of these is the perception of the environment by the managers who have to decide about the integration of IoT-based smart technology in their touristic offers. Such perception and the adoption decision revolve around three levels of elements respectively benefits, risks, and barriers associated with the integration of IoT in the current offering and its servicescape (Roy et al., 2019). Secondly, the interconnected nexus of elements intervening into the decision of adoption are summarized into other the decision-maker(s)' perceptions specifically: the sector competition, the extent to which IoT is considered as a viable innovation, and the level of technological competence possessed by the company (Inanc–Demir and Kozak, 2019). Likewise, the operational mode of the company, annual vs seasonal, emerged as another aspect to be considered regarding the willingness to adopt IoT technology in the tourism industry (Pappas, 2018).

The first resulting solution (S1 – rational decision-maker) deals with the evaluation of risks and opportunities associated with adopting IoT. Within this solution, the accommodation managers try to examine the perceived risks and barriers in balancing beneficial and adverse effects of adopting IoT. Competition, innovation and technology competence are instead not included. S1 proposes a holistic view of the IoT potential benefits and risks in term of the resources needed to integrate an IoT infrastructure into the business model of an accommodation. In particular, the inclusion of operational mode (f_om) tells us that different types of accommodation consider IoT benefits and risks according to the type of tourists they target. While several studies remarked the benefits arising from integrating IoT solutions into business processes in terms of cost reduction and better service offered to final users (Haddud et al., 2017; Pizam, 2017), the decision to adopt IoT requires high initial investments in term of financial resources, personnel training, and organizational redesign that could be unsustainable for small businesses (Saarikko et al., 2017). As a result, managers need to evaluate the potential barriers that could reduce the appeal of adopting IoT for specific industries (Caputo et al., 2016; Kamble et al., 2019). The evaluation to adopt IoT or not should be included in a larger picture where additional digitalization paradigms that can enhance the touristic experience are considered in connection with IoT, such as Big Data and Artificial Intelligence (Inanc–Demir and Kozak, 2019).

The second solution (S2 – enthusiast decision-maker) comprises the internal and external competitive benefits related to the possible adoption of IoT, by including operational mode, competition and innovation. S2 shows that IoT could be used to gain a robust and sustainable competitive advantage; specifically, it can strengthen the strategic positioning by offering breakthrough innovations revolutionizing the business model of a hotel or of other types of accommodation. As previously noted, IoT shortly will be able to extensively reshape competitive advantage and the dynamics for entire industries similar to what happened into the manufacturing and logistics sector (Saarikko et al., 2017; Trequattrini et al., 2016). Following the market reshaping inducted by IoT, fast movers can gain a defendable and strong competitive position in comparison to latecomers (Westergren et al., 2017; Pizam, 2017; Buhalis et al., 2019). However, IoT could generate a robust competitive advantage only if the customers of the accommodation perceive this element as beneficial during their stay (Pizam, 2017; Buhalis et al., 2019; Roy et al., 2019). Therefore, evaluating the customers' needs and expectations is essential also to leverage the co-created experience via smart solutions that in turn will affect loyalty and word of mouth marketing (Roy et al., 2019).

The third solution (S3 – cautious decision-maker) stimulates a reflection around the potential drawbacks and challenges associated with the amount of resources needed to effectively implement IoT (Buhalis et al., 2019). S3 includes mostly external factors in the decision-making process, namely the evaluation of perceived risks, barriers and competition, balanced with the technological competence of the manager. The necessary competencies needed for the inclusion of IoT elements into the business model could be relevant and costly to be acquired and developed (Haddud et al., 2017). Moreover, customer worries about privacy and their unfamiliarity with smart technologies may hinder the benefits of IoT adoption (Střelák et al., 2016). Therefore, S3 highlights a predominance of negative perceptions, based on risks and barriers, rather than the consideration of benefits, in the decision to adopt IoT depending on the technological competence of the manager.

Finally, the fourth solution (S4 – futurist decision-maker) pertains to a reflection about future technological necessities, in terms of operational mode, benefits and innovation, related to the increasing digitalization of the overall accommodation industry (Bogicevic et al., 2017; Pizam, 2017; Buhalis et al., 2019). A report from McKinsey (Bhattacharjee et al., 2017) showed that several hospitality companies started to equip rooms and lobbies with virtual assistants producing a new type of smart servicescape. In S4, the willingness to adopt IoT is considered as a way to anticipate future trends and consequentially to preserve competitive positions in the industry. The trend identified by Buhalis et al. (2019), and McKinsey (Bhattacharjee et al., 2017) showed that the hospitality and tourism sectors are moving toward a more pervasive offering based on extra-sensory, hyper-personalized, and beyond-automation integration. In this changing environment, IoT is an enabling technology that can create smart environments aiming to redefine how customers navigate their experiences. Examples of a near-future are related to the reengineering of operational steps such as check-in and check-out possibly replaced with automatic processes, room keys and access or room-service immediately available via smartphone. Similar considerations can be made about the ability to optimize pricing through more accurate analyses and predictions based on customers' or market big data (Bhattacharjee et al., 2017).

Overall the analysis of the solutions shows the existence of four type of decision-makers and related decision making processes in the accommodation industry when pertaining to the adoption of IoT. The rational decision makers, who carefully balances pros and cons based on the business model of the firm. The enthusiast type, who mostly takes into account the benefits of adoption, actually specular to the cautious decision maker, who, instead, mostly takes into account the possible drawbacks and barriers. Finally, the futurist makes decision based on the anticipation of the future trends.

5.1 Confirmation of Tenets

As shown in Table 4, the coverage of the four generated solutions by the fsQCA is acceptable (0.426). Also, all seven constructs appear in at least one sufficient configuration. This evidence confirms that every sufficient configuration includes a different combination of the examined simple conditions, even if all solutions finally lead to the same outcome (Pappas, 2018). Consequently, every attribute contributes differently to the willingness to adopt IoT. This evidence leads to the confirmation of the first tenet (T1). The four sufficient configurations include at least three attributes out of seven. It confirms that the emerged recipe includes at least two simple conditions leading to the desired outcome. This finding is in line with previous studies (Pappas, 2018; Olya and Altinay, 2016) that leads to the confirmation of the second tenant (T2). Since fsQCA is based on cases instead of variables, the solution proposed generates a combination of variables and association with such configurations (Ordanini et al., 2014). As we discussed above, emerged solutions result from a nexus of complex configurations that have an impact on the outcome, namely, the willingness to adopt IoT. Therefore, a complex configuration may affect the willingness to adopt IoT (T3). Also, since the present study used contrarian case analysis (inclusion/exclusion of attributes), the extent to which a simple condition is present or absent determines its positive or negative influence on the willingness to adopt IoT, confirming the T4. Next, according to the equifinality principle (Woodside, 2014), multiple paths could lead to the same outcome. Considering that the results in Table 4 are not particularly high, data showed that a different approach could be used to reach the same and desired outcome. T5 is, therefore confirmed. Finally, as highlighted in Table 4, the coverage of the configurations identified varies from 0.398 to 0.459. This result suggests that none of the four solutions applies in all cases and covers the entire population (Olya & Altinay, 2016). This evidence confirms the T6, which highlights that a given recipe for the willingness to adopt IoT is not relevant for all cases.

5.2 Fit and predictive validity

Most studies evaluate the extent of the inclusion of factors among the observed variables and their generated relationships by employing model fit (Pappas, 2019a). As a result, very few studies employ predictive validity (Wu et al. 2014) and suggest that a good model does not have to be dependent on a relevant good fit to observations. The current research progresses from fit to predictive validity for the models under evaluation, following the process designated by Wu et al. (2014). More specifically, the sample is divided into equally sized holdout and modelling sub-samples, in such way that the patterns of the perceptions of accommodation providers concerning IoT are a consistent indicator for the generation of a high score. The configurational models of the holdout sample are examined with the use of the modelling sub-sample, whilst the combination of the algorithm of the holdout sample is similar to that found from fsQCA for the whole sample. Then, the holdout sample is examined by the modelling sub-sample. The model was consistent by .824 (C1>.74) having a coverage of .416 (.75>C2>.25). The findings indicate a good predictive validity

5.3 fsQCA versus correlational analysis
In the service sector, most studies use correlational analysis (Pappas, 2019a). Hence, the analysis of this study is based on the comparison of fsQCA with the dominant correlational analysis in service-oriented research (regression), aiming to examine the methodological value of fsQCA. Nevertheless, it needs to be highlighted that any comparison of fsQCA with other modes of analysis must be implemented with caution due to the fact that the former employs alternative assumptions (such as complex causality) by setting different objectives, it does not use variables but focused on cases, and it progresses to the identification of the generated solutions through the provision of necessary and adequate conditions in terms of the result it examines (Ordanini et al, 2014).

The evaluation of linear relationships between the examined model's constructs was made through Structural Equation Modelling (SEM). Since all the examined items were adopted from previous research, Confirmatory Factor Analysis (CFA) was employed, whilst SEM has identified and determined the causal relationships amongst constructs. Following Martens (2005) χ^2 ratio is the most common measure, and when it is non-significant it showcases a good fit. When large samples (as in this case) are examined, χ^2 should be divided with the degrees of freedom (χ^2/df) (Chen and Chai, 2007). Kline (2010) suggests that there are numerous fit indices that can be used, but the most important are four of them (χ^2; Comparative Fit Index [CFI]; Standardised Root-Mean-Square Residual [SRMR]; Root-Mean-Square Error of Approximation [RMSEA]). The findings have generated the following results: χ^2=512.367, df=278, χ^2/df=1.843 (acceptable value is $0\leq\chi^2/df\leq2$ [Schermelleh-Engel, Moosbrugger, and Müller, 2003]), CFI=.911 (acceptable value is close to 1.0 [Weston and Gore, 2006]), SRMR=.729 (acceptable value is when SRMR<.8 [Hu and Bentler, 1999]), and RMSEA=.435 (acceptable value is when RMSEA<.5 [Browne and Cudeck, 1993]).

Factor analysis has identified the study's important components. All values less than .4 have been suppressed (minimum acceptable value is .4 [Norman and Streiner, 2008]). The evaluation of internal consistency was measured through Crombach's A, whilst in all constructs, the values have exceeded .7 (minimum value .7 [Nunnally, 1978]). Convergent validity was measured by Average Variance Explained (AVE), and in all cases, it has exceeded .5 (minimum acceptable value .5 [Kim, 2014]), whilst in all constructs, Composite Reliability (CR) has exceeded AVE's scores. The loadings of factor analysis are presented in Table 5.

Please insert here Table 5: Factor analysis

Figure 2 illustrates the study's endogenous variables. The overall R^2 of the linear model was .15. The categorical variable of operational mode appears to impact most examined constructs (except 'perceived barriers'), mostly influencing 'competition' and 'technology competence'.

Please insert here Figure 2: IoT adoption in Greek accommodation businesses.

The study has further focused on the comparison of asymmetric (fsQCA) with correlational (regression) analysis. Despite the fact that each analysis has used different algorithms, the research has followed the comparison mode of other previous studies (Ordanini et al., 2014; Pappas, 2019b) and examined their findings. It has evaluated the ability of the respective methods to better highlight the produced complex patterns. The study compared the ability of each method to express the different influences and potentially identify alternative routes that are able to lead to the same outcome, and the coverage extent of the sample under examination.

The results showcase that regression is limited to the provision of a single pathway (i.e.: the linear influence of operational mode of the examined constructs: perceived benefits, risks, and barriers; competition; innovation; technology competence) and the effect of the latter on the intention to use IoT. As it is apparent, parametric analysis cannot adequately encapsulate the full range of alternative combinations and effects that can lead to the same outcome, while this is considered as an inseparable and permanent element of complexity (Pappas, 2019a). For example, SEM analysis appears to suggest that 'perceived risks' and 'perceived barriers' do not influence the 'intention to use IoT'. Conversely, both simple conditions are included in two generated solutions (S1; S3), able to influence IoT usage intention. One more aspect is that all four generated sufficient configurations produce a much higher row coverage (between .399 and .459) and consistency (over .8), compared with the parametric results that offered a low R^2 (.15).

6. Conclusion

In the present research, we focused our attention on the willingness to adopt IoT innovations among the Greek accommodation businesses (annual and seasonal). The present paper stems from the idea that in order to remain competitive, the accommodation industry should embrace the benefits coming from smart technologies that could permit and extension of the services offered (Pizam, 2017; Buhalis et al., 2019). From a practical viewpoint, we identified four possible types of decision-making, based on the combinations of the various cases investigated.

The first type of decision making (S1), which we called rational, mainly deals with the evaluation of risks and opportunities in adopting IoT. Conversely, the second type (S2), named enthusiast, deals with the possible competitive benefits coming for IoT. The third one (S3), named cautious, mainly focused on potential drawbacks resulting from the introduction of this emerging technology. Finally, the fourth and final type (S4), named futurist, encompasses a decision-making type based on the anticipation of the future necessities of the hotel industries concerning IoT adoption in consideration of changing market trends within the tourism industry. Each type constitutes a type of decision-maker and possibly a related decision-making style that impact the strategic behavior of the overall organization, in our case the accommodation business, when it comes to the adoption of IoT. Even if our study did not focus on the performances and results of such adoption, but limited its scope to the perception and willingness to adopt IoT, it is reasonable to assume that depending on the type of decision-making employed the results would differ. In this vein, future research could start from our typology of decision-maker to further investigate their performances, from one avenue, and the antecedent and characteristics of such types, from another. Despite our study considering IoT solutions, we posit that our results can be generalized either to other type of innovations or to other sectors.

From a practical point of view, managers should consider IoT as a viable source of competitive advantage that could act at two different levels. The first level is the front-office or customers' point of view, by offering extra-sensory and hyper-personalized experiences that could attract particular categories of tourist. Considering the operational side, IoT adoption could help reducing inefficiencies in routine operations thanks to a constant monitoring of appliances and resource usages.

This contributes to the reduction of waste and increases the overall sustainability footprint of the business (e.g. Rosato et al., 2020).

This paper also offers methodological contributions as it further refines the use of the fsQCA method and fuzzy logics in management studies, particularly to the thematic areas of tourism and services sector studies, innovation and business model research. The study supported the claim that non-linear methods are suitable to explore the complexity of both the environment for the tourism sector and its associated decision-making.

Alongside its contributions, the study has also some limitations. The use of a cross-sectional survey from a single country is a limitation, which opens up avenues for future research to test and extend the study results in different countries and by adopting different research methods (Pappas, 2018), both qualitative and quantitative including for example a longitudinal analysis. Such extension would allow to compensate the possible geographical bias in the resulted solutions. Future researchers could also expand the validity of this study by focusing on different industries to contribute to a more comprehensive understanding of the adoption decisions of IoT and smart technologies. Future avenues of research could also exist in the exploration of specific strategies to facilitate the implementation and adoption of IoT at the different stage of the value chain, according to the different type of decision-making permeating the organization, and within the different aspects of the servicescape. Moreover, future research could also focus on the investigation of the role played by cognitive biases and personality (e.g., Abatecola et al., 2018) in the decision-making process concerning the adoption of smart technologies.

References

Abatecola, G., Caputo, A. & Cristofaro, M. (2018). Reviewing cognitive distortions in managerial decision making: Toward an integrative co-evolutionary framework. *Journal of Management Development*, 37(5), 409-424. doi:10.1108/JMD-08-2017-0263

Allison, P.D. (2001). *Missing data*. Thousand Oaks: Sage Publications.

Almobaideen, W., Krayshan, R., Allan, M., & Saadeh, M. (2017). Internet of Things: Geographical Routing based on healthcare centers vicinity for mobile smart tourism destination. *Technological Forecasting and Social Change*, *123*, 342-350.

Bhattacharjee, D., Seeley, J., Seitzman, N. (2017). Advanced analytics in hospitality. McKinsey Digital. Accessed, 07th November 2019, URL: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/advanced-analytics-in-hospitality

Bogicevic, V., Bujisic, M., Bilgihan, A., Yang, W., & Cobanoglu, C. (2017). The impact of traveler-focused airport technology on traveler satisfaction. *Technological Forecasting and Social Change*, *123*, 351-361.

Browne M.W., Cudeck, R. (1993). Alternative ways of assessing model fit. In: Bollen, K.A., Long J.S. (Eds.) *Testing Structural Equation Models*. Sage, Beverly Hills, CA, pp.136-162.

Buhalis, D., & Amaranggana, A. (2015). Smart tourism destinations enhancing tourism experience through personalisation of services. In Tussyadiah I. & Inversini A., *Information and communication technologies in tourism 2015* (pp. 377-389). Springer, Cham.

Buhalis, D., Harwood, T., Bogicevic, V., Viglia, G., Beldona, S., & Hofacker, C. (2019). Technological disruptions in services: lessons from tourism and hospitality. *Journal of Service Management*. In press.

Caputo, A., Marzi, G., & Pellegrini, M.M. (2016). The internet of things in manufacturing innovation processes: development and application of a conceptual framework. *Business Process Management Journal*, *22*(2), 383-402.

Centobelli P., & Ndou V. (2019) Managing customer knowledge through the use of big data analytics in tourism research, *Current Issues in Tourism*, *22*(15), 1862-1882.

Chen, C.M., Tsai, Y.C., & Chiu, H.H. (2017). The decision-making process of and the decisive factors in accommodation choice. *Current Issues in Tourism*, *20*(2), 111-119.

Cocosila, M., & Trabelsi, H (2016). An integrated value-risk investigation of contactless mobile payments adoption. *Electronic Commerce Research and Applications,* 20, 159-170.

Fakhar-Manesh M., Pellegrini M.M., Marzi G., & Dabic M. (2020). Knowledge management in the fourth industrial revolution: Mapping the literature and scoping future avenues. *IEEE Transactions on Engineering Management*, online first, DOI:10.1109/TEM.2019.2963489.

Farazmand, A. (2003). Chaos and transformation theories: a theoretical analysis with implications for organization theory and public management. *Public Organisation Review*, 3(4), 339-372.

Femenia-Serra, F., Perles-Ribes, J.F., & Ivars-Baidal, J.A. (2019). Smart destinations and tech-savvy millennial tourists: hype versus reality. *Tourism Review*. *74*(1), 63-81.

Fitzgerald, L.A., & Van-Eijnatten, F.M. (2002). Reflections: chaos in organizational change. *Journal of Organizational Change Management*, *15*(4), 402-411.

Gao, L., & Bai, X. (2014). A unified perspective on the factors influencing consumer acceptance of internet of things technology. *Asia Pacific Journal of Marketing and Logistics*, 26(2), 211-231.

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

Guinard, D., Trifa, V., Karnouskos, S., Spiess, P. and Savio, D. (2010). Interacting with the SOA-based internet of things: discovery, query, selection, and on-demand provisioning of web services. *IEEE Transactions on Services Computing*, *3*(3), 223-235.

Haddud, A., DeSouza, A., Khare, A., & Lee, H. (2017). Examining potential benefits and challenges associated with the Internet of Things integration in supply chains. *Journal of Manufacturing Technology Management*, *28*(8), 1055-1085.

Ho, S.M., Ocasio-Velázquez, M., & Booth, C. (2017). Trust or consequences? Causal effects of perceived risk and subjective norms on cloud technology adoption. Computers & Security, 70, 581-595.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling: A Multidiciplinary Journal*, 6(1), 1-55.

Inanc–Demir, M., & Kozak, M. (2019). Big Data and Its Supporting Elements: Implications for Tourism and Hospitality Marketing. In *Big Data and Innovation in Tourism, Travel, and Hospitality* (pp. 213-223). Springer, Singapore.

Kamble, S.S., Gunasekaran, A., Parekh, H., & Joshi, S. (2019). Modeling the internet of things adoption barriers in food retail supply chains. *Journal of Retailing and Consumer Services*, *48*, 154-168.

Kent, R.A., & Argouslidis, P.C. (2005). Shaping business decisions using fuzzy-set analysis. *Journal of Marketing Management*, *21*(5-6), 641-658.

Kim, J.H. (2014). The antecedents of memorable tourism experiences: The development of a scale to measure the destination attributes associated with memorable experiences. *Tourism Management*, 44, 34-45.

Kline, R.B. (2010). *Principles and practice for structural equation modelling*. 3rd Eds. Guildford Press, New York, NY.

Koo, C., Tussyadiah, I.P., & Hunter, W.C. (2017). Special issue on how technology-enhanced tourism is transforming societies, cultures and economies. *Technological Forecasting and Social Change*, *123*, 327-329.

Kozak, M., & Buhalis, D. (2019). Cross–border tourism destination marketing: Prerequisites and critical success factors. *Journal of Destination Marketing & Management*, 14, 100932.

Kretzschmar Jr., W.A. (2015). *Language and Complex Systems*. Cambridge: Cambridge University Press.

Law, R., Buhalis, D., & Cobanoglu, C. (2014). Progress on information and communication technologies in hospitality and tourism. *International Journal of Contemporary Hospitality Management*. *26*(5), 727-750.
Lawrence, W.L., Feng, Y.L., & Huang, Y.C. (2003). Diagnosis of Freeway traffic incidents with chaos theory. *Journal of the Eastern Asia Society for Transportation Studies*, 5, 2025-2038.
Levy, D. (1994). Chaos theory and strategy: theory, application and managerial implications. *Strategic Management Journal*, 15(2), 167-178).
Lin, Y. (2011). The application of the Internet of things in Hainan tourism scenic spot. In "*2011 seventh international conference on computational intelligence and security*" (pp. 1549-1553), Hainan, IEEE, DOI: 10.1109/CIS.2011.347.
Longest, K., & Vaisey, S. (2008). Fuzzy: A program for performing Qualitative Comparative Analyses (FSQCA) in STATA. *The STATA Journal*, *8*(1), 79-104.
Mariani, M. (2020). Big data and analytics in tourism and hospitality: A perspective article. *Tourism Review*. *75*(1), 299-303.
Martens, M.P. (2005). The use of Structural Equation Modeling in counseling psychology research. *The Counseling Psychologist*, 33, 269-298.
Mishra, A., Karmakar, A., Ghatak, A., Ghosh, S., Ojha, A., & Patra, K. (2019). Low cost parking system for smart cities: A vehicle occupancy sensing and resource optimization technique using iot and cloud paas. *International Journal of Scientific and Technology Research*, 8(9), 115-122.
Nolich, M., Spoladore, D., Carciotti, S., Buqi, R., & Sacco, M. (2019). Cabin as a home: a novel comfort optimization framework for IoT equipped smart environments and applications on cruise ships. *Sensors*, *19*(5), 1060-1084.
Norman, G., & Streiner, D. (2008). *Biostatistics: The bare essentials*. 3rd Eds. Decker, Hamilton.
Nunnally, J.C. (1978). *Psychometric theory*. 2nd Eds., New York, NY: McGraw-Hill.
Olmedo, E. (2011). Is there chaos in the Spanish labour market? *Chaos, Solitons and Fractals*, 44(12), 1045-1053.
Olya, H.G., & Altinay, L. (2016). Asymmetric modeling of intention to purchase tourism weather insurance and loyalty. *Journal of Business Research*, *69*(8), 2791-2800.
Ordanini, A., Parasuraman, A., & Rubera, G. (2014). When the recipe is more important than the ingredients: A qualitative comparative analysis (QCA) of service innovation configurations. *Journal of Service Research*, *17*(2), 134-149.
Ozturk, A.B., Bilgihan, A., Salehi-Esfahani, S., Hua, N. (2017). Understanding the mobile payment technology acceptance based on valence theory: A case of restaurant transactions. *International Journal of Contemporary Hospitality Management*, 29(8), 2027-2049.
Pappas, N. (2015). Achieving competitiveness in Greek accommodation establishments during recession. *International Journal of Tourism Research*, 17(4), 375-387.
Pappas, N. (2018). Hotel decision-making during multiple crises: A chaordic perspective. *Tourism Management*, *68*, 450-464.
Pappas, N. (2019a). The complexity of consumer experience formulation in the sharing economy. *International Journal of Hospitality Management*, 77, 415-424.
Pappas, N. (2019b). UK outbound travel and Brexit complexity. *Tourism Management*, 79, 12-22.
Park, E., Cho, Y., Han, J., & Kwon, S.J. (2017). Comprehensive Approaches to User Acceptance of Internet of Things in a Smart Home Environment. *IEEE Internet of Things Journal*, 4(6), 2342-2350.
Pizam, A. (2017). The internet of things (IoT): The next challenge to the hospitality industry. *International Journal of Hospitality Management*, *100*(62), 132-133.
Ragin, C.C. (2000). *Fuzzy-set Social Science*. Chicago, IL: University of Chicago Press.
Rosato, P. F., Caputo, A., Valente, D., & Pizzi, S. 2030 Agenda and sustainable business models in tourism: A bibliometric analysis. *Ecological Indicators*, 121, 106978.

Roy, S. K., Singh, G., Hope, M., Nguyen, B., & Harrigan, P. (2019). The rise of smart consumers: role of smart servicescape and smart consumer experience co-creation. *Journal of Marketing Management*, *35*(15-16), 1480-1513.

Saarikko, T., Westergren, U.H., & Blomquist, T. (2017). The Internet of Things: Are you ready for what's coming?. *Business Horizons*, *60*(5), 667-676.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Test of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research – Online*, 8(2), 23-74.

Skarmeas, D., Leonidou, C.N., & Saridakis, C. (2014). Examining the role of CSR skepticism using fuzzy-set qualitative comparative analysis. *Journal of Business Research*, *67*, 1796-1805.

Statista (2020*). Number of travel accommodation establishments in Greece in 2018, by type*. Accessed 16th June 2020. URL: https://www.statista.com/statistics/413417/number-of-travel-accommodation-establishments-in-greece/

Stoelák, D., Škola, F., & Liarokapis, F. (2016). Examining user experiences in a mobile augmented reality tourist guide. Paper presented at the *ACM International Conference Proceeding Series, 29-June-2016.* doi:10.1145/2910674.2935835

Tan, K.S., Chong, S.C., Lin, B., & Eze, U.C. (2009). Internet-based ICT adoption: eEvidence from Malaysian SMEs. *Industrial Management & Data Systems*, 109(2), 224-244.

Trequattrini, R., Shams, R., Lardo, A., & Lombardi, R. (2016). Risk of an epidemic impact when adopting the internet of things: the role of sector-based resistance. *Business Process Management Journal*, *22*(2), 403-419.

Van-Eijnatten, F.M., Putnik, G.T., & Sluga, A. (2007). Chaordic systems thinking for novelty in contemporary manufacturing. *CIRP Annals - Manufacturing Technology*, *56*(1), 447-450

Wang, Y.S., Li, H.T., Li, C.R., & Zhang, D.Z. (2016). Factors affecting hotels' adoption of mobile reservation systems: A technology-organization-environment framework. *Tourism Management*, 53, 163-172.

Westergren, U.H., Saarikko, T., & Blomquist, T. (2018). Initiating the Internet of Things: Early Adopters' Expectations for Changing Business Practices and Implications for Working Life. In *The Internet of People, Things and Services* (pp. 111-131). Routledge..

Weston, R., & Gore, P.A.Jr. (2006). A brief guide to Structural Equation Modeling. *The Counseling Psychologist*, 34(5), 719-751.

Woodside, A.G. (2013). Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory. *Journal of Business Research*, 66(4), 463-472.

Woodside, A.G. (2014). Embrace•perform•model: Complexity theory, contrarian case analysis, and multiple realities. *Journal of Business Research*, 67, 2495-2503.

Woodside, A.G., & Zhang, M. (2013). Cultural diversity and marketing transactions: Are market integration, large community size, and world religions necessary for fairness in ephemeral exchanges? *Psychology and Marketing*, 30(3), 263-276.

World Bank (2020). *International tourism, number of arrivals – Greece*. Accessed 16th June 2020, URL: https://data.worldbank.org/indicator/ST.INT.ARVL?locations=GR

World Data Atlas (2020). *Greece - Contribution of travel and tourism to GDP as a share of GDP*. Accessed 16th June 2020, URL: https://knoema.com/atlas/Greece/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP-percent-of-GDP

Wu, P.L., Yeh, S.S., Huan, T.C., & Woodside, A.G. (2014). Applying complexity theory to deepen service dominant logic: Configural analysis of customer experience-and-outcome assessments of professional services for personal transformations. *Journal of Business Research*, 67(8), 1647-1670.

Zhang, Y., Zhao, L., & Qian, C. (2017). Modeling of an IoT-enabled supply chain for perishable food with two-echelon supply hubs. *Industrial Management & Data Systems*, *117*(9), 1890-1905.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Figures and tables in order of appearance in the text

Figure 1: The proposed model.

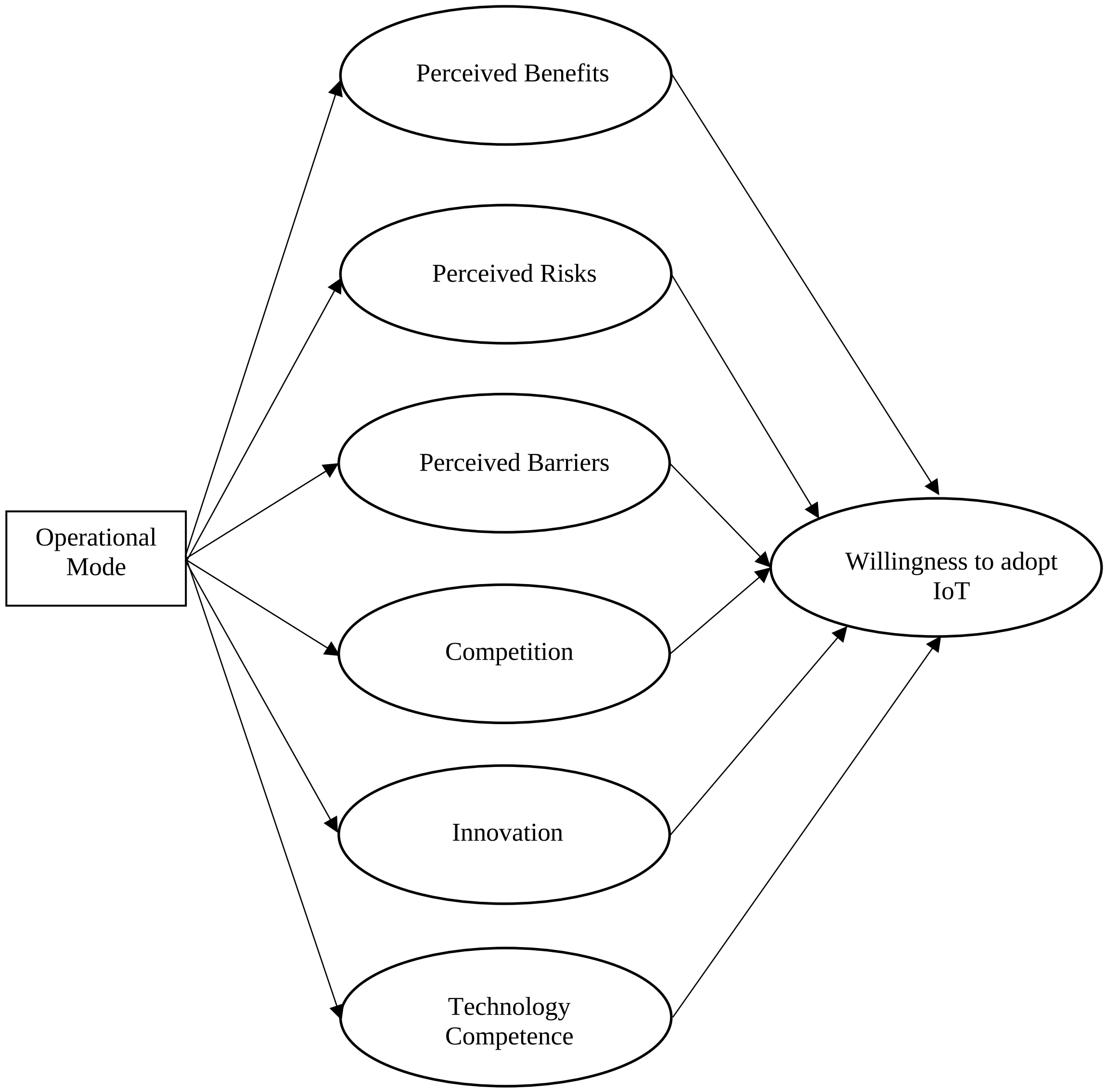

Table 1: Correlation matrix

		1	2	3	4	5	6	7
1	Perceived Benefits	1						
2	Perceived Risks	.051	1					
3	Perceived Barriers	.007	.011	1				
4	Competition	.046	.102*	.016	1			
5	Innovation	-.065	.015	.028	.013	1		
6	Technology Competence	.117**	.073	.092*	.097*	.079	1	
7	Willingness to Adopt IoT	-.029	-.008	-.007	-.019	.041	.135**	1

*Correlation is significant at the 0.05 level.
**Correlation is significant at the 0.01 level.

Table 2: Descriptive statistics

	Statements	Means	SD	Operational Mode		Kurtosis	Skewness
				Annual	*Seasonal*		
	Perceived Benefits						
PB1	IoT can reduce my business costs	3.98	.633	4.07	3.92	.900	-.438
PB2	PB2: IoT can speed up my business communications	3.78	.827	3.85	3.74	.782	-.743
PB3	IoT can provide higher reliability upon my business communications	3.64	.939	3.64	3.64	-.039	-.725
PB4	IoT is an efficient means for coordination among firms	3.70	.875	3.85	3.61	-.280	-.597
PB5	IoT can provide closer relationship among trading partners	3.58	.918	3.70	3.50	-.706	-.380
PB6	IoT can provide better customer communications	4.07	.671	4.17	4.01	.392	-.425
PB7	IoT can generate new business opportunities	4.05	.663	4.14	3.98	.581	-.444
PB8	Through IoT I can access further market information and knowledge	3.91	.648	3.99	3.86	.133	-.211
PB9	Through IoT I can improve my business management and organization facilitation	3.67	.866	3.78	3.59	-.417	-.443
	Perceived Risks						
PR1	By using IoT there is a risk that my corporate data stored on, and managed by, cloud storage services providers will not be secure.	3.67	.938	3.81	3.58	.591	-.845
PR2	By using IoT there is a risk that my corporate data stored on, and managed by, cloud storage services providers will not be well protected.	3.83	.956	3.99	3.73	.462	-.820
PR3	By using IoT there is a risk that service providers of cloud storage solution will not perform due diligence and will not secure our corporate data.	3.51	1.012	3.58	3.46	-.502	-.522
PR4	By using IoT I should consider the risk that fraudulent behaviour may exit through hacking by stealing and leaking sensitive information.	3.96	.958	4.08	3.87	.635	-.926
PR5	By using IoT I feel that there will be an increasing overdependence of technology.	3.56	.847	3.64	3.50	.281	-.316
	Perceived Barriers						
PBA1	IoT in unsuitable for my business.	2.84	.906	2.84	2.83	-.336	.193
PBA2	It is difficult to find personnel with appropriate knowledge in IoT.	3.08	.940	3.09	3.08	-.726	-.259
PBA3	I don't have sufficient network infrastructure for supporting IoT.	3.07	.840	3.10	3.06	-.409	-.159
PBA4	Employing IoT has a high cost.	3.41	1.084	3.38	3.43	-.888	-.141
PBA5	IoT has an expensive software.	3.31	1.068	3.29	3.32	-1.034	-.060

PBA6	IoT has unbalanced investment costs and returned benefits.	2.71	.939	2.71	2.71	-.393	.262
PBA7	The laws concerning IoT are not clear.	3.06	1.027	2.99	3.11	-.645	.229
PBA8	I don't trust the provided security of IoT.	3.12	1.115	3.11	3.13	-.793	.254
	Competition						
C1	My hotel will experience competitive pressure to introduce IoT.	4.27	.627	4.41	4.18	.964	-.608
C2	My hotel will gain a competitive disadvantage if IoT is adopted.	3.98	.885	4.14	3.86	-.010	-.744
C3	We may lose customers to our competitors if we do not adopt IoT.	3.85	.903	4.00	3.76	-.561	-.438
C4	We feel that it is a strategic necessity to introduce IoT in order to be competitive in the current market.	4.22	.851	4.56	3.99	.214	-.932
	Innovation						
I1	IoT will be innovative for our hotel's services.	4.10	.831	4.29	3.96	.543	-.899
I2	IoT will be innovative for our hotel's marketing.	4.09	.619	4.17	4.04	1.261	-.494
I3	IoT will be innovative for our hotel's human capital.	3.76	.953	3.86	3.69	.140	-.844
I4	IoT will be innovative for our hotel's Information Technology.	4.28	.649	4.37	4.21	.285	-.556
I5	IoT will be innovative for our hotel's collaboration activities.	3.50	1.076	3.58	3.45	-1.011	-.418
	Technology Competence						
TC1	The information technology infrastructure of my hotel is able to support IoT-related applications.	3.48	.803	3.71	3.32	-.066	-.396
TC2	My hotel is dedicated to ensuring that employees will be familiar with IoT-related technology.	3.65	.842	3.94	3.46	.015	-.436
TC3	The employees of my hotel should contain a high level of IoT-related knowledge complexity.	3.29	.909	3.49	3.15	-.446	-.307
TC4	We believe that an IoT is complex to implement.	3.74	.910	3.84	3.67	-.558	-.296
TC5	We believe that developing an IoT is a complex process.	3.88	.918	3.96	3.83	-.474	-.464
TC6	Integrating an IoT into our work practice is very difficult.	3.41	1.120	3.56	3.31	-.790	-.299
	Willingness to Adopt IoT						
WA1	Given the chance I intend to use IoT.	3.65	.945	3.93	3.46	-.067	-.525
WA2	I am willing to use IoT in the near future.	3.11	1.211	3.25	3.02	-1.047	-.164
WA3	I plan to use IoT.	3.80	.970	4.10	3.60	-.051	-.632
WA4	I will recommend IoT to others.	3.98	.957	4.28	3.78	-.290	-.683
WA5	I predict that I should use IoT.	4.07	.940	4.36	3.87	-.183	-.778

Table 3: Profile of enterprises

Operational Mode	**N**	**%**
Annual	214	40,5
Seasonal	314	59,5
Total	*528*	*100*

Table 4: Complex solutions for the Internet of Things

Complex Solution	**Raw Coverage**	**Unique Coverage**	**Consistency**
Model: f_wa=f(f_om,f_pb,f_pr,f_pba,f_c,f_i,f_tc)			
S1: f_om*f_pb*f_pr*f_pba*~f_c*~f_i*~f_tc	0.43059	0.12847	0.86837
S2: f_om*~f_pb*~f_pr*~f_pba*f_c*f_i*~f_tc	0.45947	0.14625	0.84273
S3: ~f_om*~f_pb*f_pr*f_pba*f_c*~f_i*f_tc	0.39893	0.13840	0.81028
S4: f_om*f_pb*~f_pr*~f_pba*~f_c*f_i*~f_tc	0.41482	0.11834	0.80581
Solution Coverage: 0.42635	*Solution Consistency*: 0.82894		

f_om: Operational mode	f_pb: Perceived benefits
f_pr: Perceived risks	f_pba: Perceived barriers
f_c: Competition	f_i: Innovation
F_tc: Technology competence	f_wa: Willingness to adopt Internet of Things

Table 5: Factor analysis

Statement	**Loading**	**A**	**AVE**	**CR**
Perceived Benefits		.913	.629	.937
PB1	.930			
PB2	.729			
PB3	.546			
PB4	.788			
PB5	.722			
PB6	.854			
PB7	.882			
PB8	.854			
PB9	.766			
Perceived Risks		.927	.771	.944
PR1	.945			
PR2	.911			
PR3	.848			
PR4	.842			
PR5	.840			
Perceived Barriers		.917	.650	.936
PBA1	.902			
PBA2	.908			
PBA3	.851			
PBA4	.778			
PBA5	.692			
PBA6	.825			
PBA7	.740			
PBA8	.724			
Competition		.866	.683	.896
C1	.798			
C2	.859			
C3	.845			
C4	.801			
Innovation		.769	.607	.860
I1	LC			
I2	.824			
I3	.829			
I4	.713			
I5	.744			
Technology Competence		.889	.651	.917

TC1	.892			
TC2	.799			
TC3	.746			
TC4	.896			
TC5	.812			
TC6	.674			
Willingness to Adopt IoT		.891	.725	.928
WA1	.885			
WA2	.604			
WA3	.930			
WA4	.922			
WA5	.872			

LC: Eliminated due to low commonality

Figure 2: IoT adoption in Greek accommodation businesses.