



**Relationship between Information and Communication
Technology and competitiveness in the tourism industry: A mapping
review**

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Abstract

The main goal of this study is to review several previously published papers about the relationship between Information and Communication Technology and competitiveness in the tourism industry, to determine trends, research approaches and contextualization of former studies. Ninety papers were selected from the most visited journal databases of scientist papers related to tourism and technology: ScienceDirect, Scopus, Web of Science, ProQuest, EBSCO, DOAJ, and Emerald. Once applied the Systematic Mapping Review methodology, it was found that there are four major categories in which the relationship between the constructs can be grouped competitiveness and Information and Communication Technology; direct positive relationship, negative relationship, no relationship and positive relationship through other factors. Currently, there is consensus between researchers and professionals about the positive relationship between Information and Communication Technology and competitiveness on the tourism industry from the macroeconomic point of view. However, at a microeconomic level, the discussion has not yet been resolved since the adoption of technology or any other type of resource can generate dissimilar results in different companies given the characteristics of each firm. Future lines of research should focus on determining what the factors are, and under what conditions the digitalization of firms translates into improvements in their productivity and competitiveness.

Keywords: Competitiveness. Information and Communication Technology. Productivity. Tourism industry. e-tourism.

1 INTRODUCTION

The study of competitiveness and the factors that determine it has been of special interest by the scientific community, professionals and policy makers because of the importance of the subject in terms of positioning cities, regions and countries on international markets, its impact on economic growth and potential in the generation of high standard of living for the citizens. Although there is no consensus between scholars and practitioners about one unique definition of the term (SARGSYAN, 2018), competitiveness can be defined as the collection of factors, policies and institutions which determine the level of productivity and prosperity that can be attained by a given economy (GIEGIEL; WILDOWICZ, 2014).

In the case of the tourism industry, competitiveness is understood as the capacity of a destination to increase and maintain high levels of tourist incomes. Based on high benefit products and services, optimizing the use of resources that satisfy visitor expectations, and which result on an improvement in the quality of life of citizens, while guaranteeing a sustainable development of tourist attractions. Although the issue of the competitiveness of tourist destinations has been widely studied, and the knowledge about the factors that generate it has deepened in recent years, the impact of information and communications technology on the destination competitiveness has not been given special attention (PETROVIĆ; MILIĆEVIĆ; DJERI, 2017).

Although the discussion of the paradox of productivity – the increase in the use of technology does not generate increases in productivity (SOLOW, 1987) not settled, several empirical studies shown how the development of computational applications, web applications, computational customer experience, analyzers and measurers, besides the widespread use of modern technology, affecting positively the productivity of tourism industry (TSAI *et al.*, 2009; PRANIČEVIĆ; ALFIREVIĆ; ŠTEMBERGER, 2011; SIRIRAK *et al.*, 2011; MIHALIČ; BUHALIS, 2012). Moreover, are a determinant key of competitiveness in this sector (BERNE; GARCIA-GONZALEZ; MUGICA, 2012; MELADZE; JERENASHVILI, 2012; MIHALIČ; PRANIČEVIĆ; ARNERIĆ, 2015; ILIĆ; NOKOLIĆ, 2018).

The importance of Information and Communication Technology – ICT in the study of competitiveness becomes evident when analyzing the worldwide more recognized monitors of competitiveness as is the case of *Travel and Tourism Competitiveness Index – TTCI* by *World Economic Forum – WEF*, *Global Competitive Index* by *WEF* and *IMD World Competitiveness Ranking*, which include within their analysis model the ICT. Likewise, there are rankings that show the progress in the appropriation and use of ICT, as they are measuring *the Information Society Report* and *ICT Development index – IDI*, published by International Telecommunications Union – ITU, *The Networked Readiness Index* by WEF, *IMD World Digital Competitiveness Ranking*, *Digital Density Index* by Accenture, and *The Digitization Index (DiGiX)* by BBVA Research, among others.

New trends such as the electronic commerce (e-commerce), electronic business (e-business), global positioning system (GPS), Internet of things (IoT), Social Context Mobile (SoCoMo), Business Intelligence, Intelligence Artificial, increased intelligence, machine learning, and other technological innovation offer significant opportunities for

tourism businesses (PASTOR *et al.*, 2014). The advances in the development of the fourth industrial revolution provide important alternatives for the tourism industry, being necessary investment and efficient management of new technologies for the positioning of emerging destinations, within the framework of an increasingly competitive tourism worldwide (CÎRSTEA, 2014; BERNÉ *et al.*, 2015; COCCOSSIS; MEXA, 2017; BACKMAN; KLAESSON; ONER, 2017).

Considering this scenery is intended to develop a review of the literature from the application of the Systematic Mapping Studies (SMS) methodology, which will allow us to carry out a state of the art of the relationship between competitiveness and ICT in the tourism industry. The principal phases of an SMR are; definition of research questions, conducting the search for relevant papers, screening of papers, keywording of abstracts and data extraction and mapping (PETERSEN; VAKKALANKA; KUZNIARZ, 2015). The SMS involves the search for the literature in order to know what topics have been covered in the literature and where the literature has been published (PETERSEN *et al.*, 2008; PETERSEN; VAKKALANKA; KUZNIARZ, 2015).

This paper allows students, researchers and professionals to know the most relevant contributions around the theoretical discussion of the ICT effect on the tourism industry competitiveness, as well as explore trends in the research area from an interdisciplinary perspective. Regarding the practical implications, the paper provides decision makers, consultants and professionals from public, private and non-governmental organizations with the basic inputs regarding contribution of technology in competitiveness, which will allow them to address the formulation of strategies and approach of solutions that demand the increasing competition between companies and tourist destinations.

In order to clarify the context for discussion and considering the phases for the development of SMS, we have defined, in the first part of the document, the existing relationship between the three concepts under analysis; ICT, competitiveness and tourism industry. In the second part, we describe the research methodology used in this study and expected results. In the third part presents the main results of mapping in relation to the topics that observed a broad approach in the literature found and the discussion about the ICT effect on competitiveness. Finally, the conclusions, recommendations and limitations of the study are presented in the final section.

2 LITERATURE REVIEW

From a general perspective tourism is defined as the set of activities of people travelling and staying in places outside their usual environment for no more than one consecutive year of leisure, business and other purposes not related to the exercise of an activity remunerated within the place visited (RISI, 2010). From an economic perspective, the tourism is defined as “[...] the set of transactions of goods and services occurring as the result of movements made by people outside of their usual residence for a period less than one year” (PULIDO, 2012, p.56).

In methodological notes from the Tourism Statistics Database of the UNWTO (2018). says that, tourism industries include those industries that typically produce tourism characteristic products; accommodation for visitors, food and beverage serving activities, railway, road, water, and air passenger transport, transport equipment rental, travel agencies and other reservation services activities, cultural activities, sports and recreational activities, retail trade of country-specific tourism characteristic goods, and other country-specific tourism characteristic activities. For Ardahaey (2011) tourism is

not an industry per se but a collection of interrelated industries, which sell products to tourists, as well as, a range of other customers: hotels, tour operators and travel agents, airlines, etc.

Tourism industry has become one of the pillars of global economic development accounting for about 10.4% of global gross domestic product (GDP) and contributes with one in 10 jobs in the world according to statistics of the World Travel and Tourism Council (WTTC, 2018). The World Tourism Organization (UNWTO, 2018) reveals that over 1,326 million international tourists were mobilized throughout 2017, evidencing that the tourism industry has become one of the economic sectors of fastest growing of our times. a sector which leads the development worldwide by creating millions of jobs, encouraging exportations and investments and improving life quality of millions of people around the world.

Given the importance of tourism in the economic and social development of countries, competition between tourist destinations to attract the largest number of international visitors and participate in the significant profits generated by tourism has increased in recent years. Therefore, there is a special interest by academics and professionals in study of competitiveness, since it is considered one of the most relevant factors for the success of tourist destinations (CROUCH; RITCHIE 1999; MIHALIČ, 2000; ENRIGHT; NEWTON 2004; GOOROOCHURN; SUGIYARTO 2005; MAZANEC; WÖBER; ZINS, 2007; ABREU-NOVAIS; RUHANEN; ARCODIA, 2016).

From the macroeconomic point of view, competitiveness is understood as the set of institutions, policies, and factors that determine the level of productivity of a country (WEF, 2017). and from the microeconomic point of view, the economic strength of firms against its rivals in the global marketplace where products, services, people and innovations move freely despite the geographical boundaries (WANG; HSU, 2010). Therefore, for the positioning of tourist destinations it becomes necessary to consider the various factors that generate competitiveness at the macroeconomic level and at the company level. The three thought schools on competitiveness: positioning, resource-based, and dynamic capabilities, have allowed better understanding of the subject from the micro and macroeconomic perspective.

The positioning view suggest that companies can achieve and maintain competitive advantage following one of the generic strategies, which are cost leadership, differentiation, and focus a niche segment in a specific geographical area (BILGIHAN *et al*, 2011). The resource-based view suggests that in order to create competitive advantage, companies need to focus on their valuable, rare, inimitable, and unsubstitutable resources (OKUMUS, 2013), and the dynamic capabilities view has been proposed what the companies can create and sustain their competitive advantage only by developing dynamic capabilities in a rapidly changing environment (EASTERBY-SMITH; PRIETO, 2008). Management of intangible; technological know-how, intellectual property, organizational culture, reputations, offering value-added products and services, and designing business models innovative, are examples of dynamic capabilities.

Among the various factors addressed in the literature for the understanding of competitiveness, ICT have gained weight in recent years given the significant increase in empirical evidence showing the positive relationship between the two constructs. Information and Communication Technologies also known by the acronym ICT in Europe and as IT in United State of America are a huge set of innovative, technological and computational creations (web or mobile apps, entire computer programs, pieces of code, algorithms, electronic and electrical devices) responsible for collecting, storage, retrieval, clean, convert, transmit, analyses and exchange information in digital format. ICT

become a tool that improves decision-making and control, if their implementation is accompanied by changes in the organizational structure, which allows optimizing its use.

Although an evolution was expected in the definition of the acronym ICT, resulting from the ongoing and exceptionally fast development of new concepts, methods, solutions and facilities supporting data processing and transferring (JAREMEN, 2016). The fact is that the term has not undergone major changes since the contributions given by Bakopoulos (1985, p.7) more than three decades ago and that referred to the IT as the [...] set of non-human resources dedicated to the storage, processing and communication of information, and the way in which these resources are organized into a system capable of performing a set of tasks.

One of the most affected industries by these technological developments is the tourism industry (FUENTES-BLASCO; MOLINER-VELÁZQUEZ; GIL-SAURA, 2017). The continuous innovation in the applications and uses of ICT in the tourism industry constantly generate changes in the administration and management of tourism companies and affecting the same structure of the value chain of the sector, especially in the marketing and distribution areas. Therefore, information becomes the core of the activities of all tourism enterprises (JAREMEN, 2016), and is an important part of the product's differentiation and quality this is an important factor in a hotel firm's business and competitiveness (MIHALIĆ *et al.*, 2015).

The advance of ICT in the different processes of the value chain of the tourism industry has generated different lines of research within which we can highlight electronic distribution (e-distribution), e-commerce, e-business, electronic marketing (e-marketing), among others. E-distribution is understood as the system of intermediaries that facilitates the sale and delivery of tourism services from suppliers to consumers (BUHALIS; LAWS, 2001, p.9), e-business is defined as the “[...] transformation of key business processes through the use of Internet technologies” (DOMALESKI, 2000, p.2), e-commerce is defined by Beatrice and Mihălcescu (2013) as the activity of sale and marketing for products and services through an electronic system such as, for example, the Internet and by e-marketing it is understood the use of electronic data and applications for planning and executing the conception, distribution and pricing of ideas, goods and services to create exchanges that satisfy individual and organizational objectives (STRAUSS; FROST, 2001).

Tourism being an information intensive industry (COX *et al.*, 2009), demands innovations in ICT, which allows increasing productivity from the optimization of information flows, through the entire value chain, reduces transaction, and operational costs (BILGIHAN *et al.*, 2011; HUO *et al.*, 2015), improved customer satisfaction, increased market share, improved performance among employees and greater operating efficiency (HUO *et al.*, 2015), what makes ICT an important factor of competitiveness in the tourism industry (MIHALIĆ; PRANIĆEVIĆ; ARNERIĆ, 2015; ŠERIĆ; SAURA; PRANIĆEVIĆ, 2016; ILIĆ; NOKOLIĆ, 2018). Therefore, it can be affirmed that the integration of ICT in the tourism industry is essential for success of tourism enterprise (BETHAPUDI, 2013).

3 METHODOLOGY REVIEW

Next, the research methodology used in this study is described.

3.1 Systematic Mapping Studies

Systematic Mapping Studies or scoping studies is a type of literature review, which seeks to answer a research question through a systematic process of analysis of scientific publications related to the object of study. The application of SMS methodology implies, among other things, to provide a broad overview of a particular research area, to establish if research evidence exists on a topic (KITCHENHAM; CHASTERS, 2007), where they are published, in which databases they have been indexed, what sorts of outcomes they have assessed, and in which populations (PETTICREW; ROBERTS, 2006).

It may include restricted searches across a limited number of key databases, limited to a certain period, and perhaps restricted by language. As well as helping to define the review question, this will allow an estimate to be made of the nature and the scale of any new review. It is methodologically acceptable, indeed, good practice, to refine the systematic review question in the light of what is learnt from the scoping review (PETERSEN *et al.*, 2008). On the other hand, a systematic literature review or systematic review is a means of identifying, evaluating and interpreting all available research relevant to particular research question, or topic area, or phenomenon of interest. Individual studies contributing to a systematic review are called primary studies; a systematic review is a form of secondary study (KITCHENHAM; CHARTERS, 2007).

Bailey *et al.* (2007) point out that

while the planning phase is similar to that of a systematic review (although the resulting protocol will generally be much shorter), the focus of a mapping study is upon the first three stages of the second phase of a review, namely: 1. identification of research (searching), 2. Selection of primary studies (inclusion/ exclusion), and, 3. Study quality assessment (bias/validity). The data extraction stage is generally much broader than that for a systematic review, and it is aimed mainly to classification and categorization (BAILEY *et al.*, 2007, p.482).

In recent years, there has been a substantial increase in the number of publications in various research topics, popularizing the use of systematic review in several disciplines such as health care, software engineering, social sciences, among others.

3.2 Question Research

This mapping study aims to identify the research developed around the analysis of the relationship between competitiveness and ICT in the tourism industry. Therefore, the following research questions are considered:

QR1: Where and how often been published on the relationship between ICT and competitiveness in the tourism industry?

QR2: What are the main topics addressed in the study of ICT and competitiveness in the tourism industry?

QR3: What were the main findings in the literature from the relationship between competitiveness and ICT in the tourism industry?

QR4: What research methodologies and measurement approaches have been used to determine the relationship between ICT and competitiveness in the tourism industry?

3.3 Search Strategy

The search strategy was carried out in two ways; on the one hand a manual search, from references in articles that have been published recently on the topic and on the other hand, a search through the seven virtual databases and keywords for the search in title abstract of papers are listed in table 1.

Table 1 - Search strings for the SMS

<i>Database</i>	<i>Results</i>	<i>Search</i>
<i>SCIENCEDIRECT</i>	45	Title-Abstr-Key (competiti*) and (touris* and ICT or "informat* technolog*")
<i>SCOPUS</i>	152	Title-Abs-Key (competiti*) and (touris*) and (ICT OR "informat* technolog*")
<i>WEB OF SCIENCE</i>	98	Topic: (competiti*) and (touris*) and (ICT or "informat* technolog*")
<i>PROQUEST</i>	245	All (competiti*) and (touris*) and ((ICT OR "informat* technolog*"))).
<i>EBSCO</i>	36	TX competiti* and touris* and ICT or "informat* tecnolog*".
<i>DOAJ</i>	45	Competiti* and informat* technolog* and touris*
<i>EMERALD</i>	170	Competiti* and touris* and ICT or "informat* technolog*"
<i>TOTAL</i>	791	

Source: Prepared by the authors.

Through the search process, we found 791 papers, which contain the search terms; competitiveness, ICT and tourism, which are filtered by taking into account the inclusion and exclusion criteria listed in the following section.

3.4 Inclusion and exclusion criteria

As it is stated in the previous item, the search was conducted from the title, keywords and abstract of the paper. The second author applied the inclusion and exclusion criteria defined previously, thus:

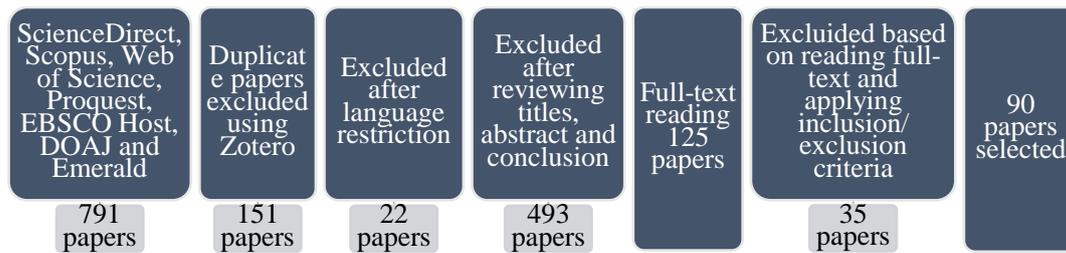
Inclusion criteria:

- were published until august 2018
- were written in English
- were available in full-text

Exclusion criteria:

- were not available in full-text
- were not books, chapters of these and grey literature

Fig. 1 - Study selection process



Source: Prepared by the authors.

Finally, we found some papers whose title and abstract are available in English, but whose content is written in other languages, especially Korean, Portuguese, Arabic and Romanian, which forced us to exclude them by the lack of knowledge of these languages by research team.

3.5 Data Collection

Once filtered the rows found have of 90 articles. The information that is extracted from each one of them is presented in (Table 2).

Table 2 - Data extraction form to collect information each identified paper.

<i>Research Question</i>	<i>Field</i>
<i>RQ1</i>	General information: title, author(s), type, source, year, keywords, abstract and journal Received citations
<i>RQ2</i>	Research topic
<i>RQ3</i>	Research results and author(s).
<i>RQ4</i>	Investigation method, estimation Method and Depend variable

Source: Prepared by the authors.

3.6 Selection of Topic Research

To answer the research questions N°. 2, related to the identification of the main research topics, the keywords are extracted from each paper and analyzed in contrast to the title of the paper, in order to select a single keyword that collects the central theme of each one of them. The paper. With this information and taking as reference other literature review papers, the definition of each of the pre-selected topics is analyzed in order to group them in a number of categories that are related and that facilitate their analysis. Finally, eight categories were defined, as follows: ICT applications, e-distribution, e-commerce, e-business, e-marketing, productivity, innovations, and others.

4 RESULTS OF THE MAPPING

Down below are the main findings of the systematic mapping, after an exhaustive analysis of the literature that was found.

4.1 Characterization of publications

Of 90 papers, which met the inclusion criteria (Fig.1), 74 correspond to articles in scientific journals, and 16 are conference papers. Total papers were found in 46 different journals. In Table 3. Presents statistics related to journals where three or more articles were found. These nine journals grouped 33% of identified papers. We used the Journal Citation Reports (JCR) from Thomson Reuters and asterisk classification of SCImago Journal Ranking (SJR), elaborated by The Spanish National Research Council (CSIC) and several Spanish universities and used as reference journals indexed in Scopus.

Table 3 - Journal source of selected papers.

<i>Journal</i>	<i>Number</i>	<i>Proportion (%)</i>	<i>Cumulative proportion (%)</i>	<i>Ranking (JCR)</i>
<i>International Journal of Contemporary Hospitality Management</i>	8	14.0	14.0	Q1
<i>Journal of Hospitality and Tourism Technology</i>	4	7.0	21.1	Q1*
<i>Tourism Management</i>	4	7.0	28.1	Q1
<i>Economic Research-Ekonomska Istraživanja</i>	3	5.3	33.3	Q3

* SCImago Journal Ranking – SJR 2018.

Source: Prepared by the authors.

The best-ranked journals in JCR and SJR are those that have a greater number of publications on the subject of this study. Considering that research related to competitiveness, and ICT in the tourism industry have been developed from different fields of knowledge, the most frequent in the listed journals categories are; hospitality, leisure, sport and tourism, and management. The 16 papers published in conferences have been selected from nine international conferences. In Table 4. Lectures are presented in which two or more papers published on the subject were found, as well as two conferences that are ranked in the CORE Ranking.

Table 4 - Conference source of selected papers.

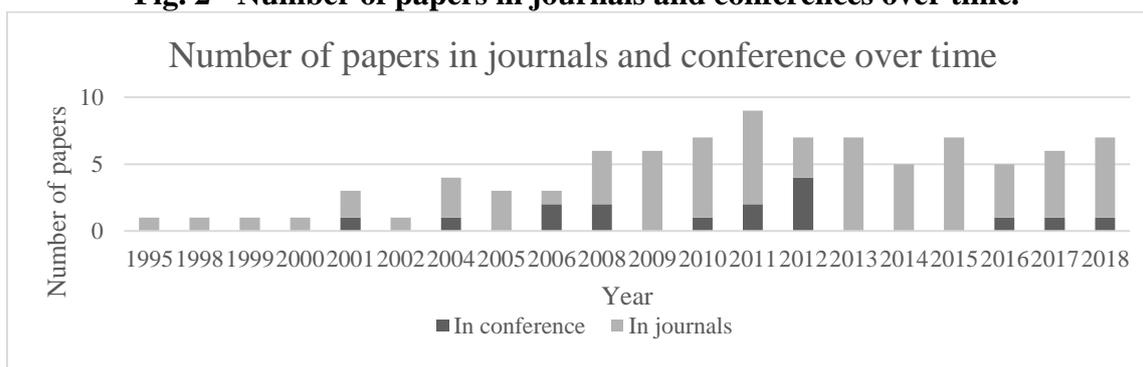
<i>Conference</i>	<i>Acronym</i>	<i>Number</i>	<i>Proportion (%)</i>	<i>Ranking (CORE)</i>
<i>International Conference In An Enterprise Odyssey</i>	ODYSSEY	4	30.8	
<i>Portland International Conference on Management of Engineering & Technology</i>	PICMET	2	15.4	A
<i>International Conference on Fuzzy Systems and Knowledge Discovery</i>	FSKD	1	7.7	C
<i>International Conference of the IADIS</i>	IADIS	1	7.7	C

Source: Prepared by the authors.

Conference, where most published papers were found on the topic of study was at

ODYSSEY, organized by the Faculty of Business & Economics from the University of Zagreb in Croatia, followed by the PICMET organized by Portland International Center for Management of Engineering and Technology. Only three conferences are classified in the Computing Research and Education Association of Australasia (CORE) Conference Rankings and ERA's rankings of conferences and journals, administered by the Australian Research Council. The conference is the most valued of PICMET in the "A" category ranking. The three classified conferences in the CORE belong to the field of artificial intelligence and image processing, building and computer software.

Fig. 2 - Number of papers in journals and conferences over time.



Source: prepared by the authors.

In the period 2006-2012 occurs the greater frequency of papers in conferences (Fig. 2), representing about 69% of the conference papers selected in this study. In the past three years there were papers related to competitiveness and ICT in the tourism sector, which have been published in the proceedings of the conference. On the other hand, it can be seen a growth in the number of papers published in the period 2009 to 2018. In this period, were published an average of 6.6 papers per year, reaching a maximum in 2011 with nine papers.

Table 5 - Top-cited identified papers.

<i>Source</i>	<i>Year</i>	<i>Received Citations</i>	<i>Authors</i>	<i>Ranking</i>
<i>Tourism Management</i>	2008	986	BUHALIS; LAWS	Q1
<i>Tourism Management</i>	1998	402	BUHALIS	Q1
<i>Information & Management</i>	2004	129	BUHALIS	Q1
<i>International Journal of Contemporary Hospitality Management</i>	2005	134	LAW; JOGARATNA	Q1
<i>Industrial Management & Data Systems</i>	2010	138	OLIVEIRA; MARTINS	Q2
<i>Journal of Travel & Tourism Marketing</i>	2009	87	LAW; LEUNG; BUHALIS	Q2

Source: Prepared by the authors.

In Table 5. The most cited papers by other papers are presented, 50% of the most cited articles correspond to the literature review and 50% are applied research. . The paper of Buhalis and Law (2008) has obtained more than 2,800 citations in Google Scholar and

986 citations in Scopus, being therefore the most relevant publication in the subject, once the SMS is applied. This year a new version of the document prepared by Navío-Marco, Ruiz-Gómez, and Sevilla-Sevilla, (2018) and published by the Tourism Management Journal, which collects advances in the theme of the last 30 years, is published.

4.2 Main issues addressed

Table 6. there is evidence that the ICT Applications is the most common topic with 20% of the papers, followed by the topic of tourism e-distribution, e-business, e-commerce, e-marketing, productivity and innovation. Within the classified papers, and other topics can be found, knowledge management, organizational structure, corporate responsibility social and virtual tourism networks.

Within the topic **ICT Applications**, were classified papers which study the effect of the use of ICT in the tourism industry, especially researches related to the adoption of a specific technology tool such as; Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), Business Intelligence (BI), Decision Support Systems (DSS), Virtual Reality (VR) and Augmented Reality (AR), Location-Based Services (LBS), machine learning, ramification, Big Data & Analytics, among others. In addition, studies related with human-device interaction as the Internet of things' technologies and wearable, where sensitization promotes new usages and experiences in tourism (NAVÍO-MARCO; RUIZ-GÓMEZ; SEVILLA-SEVILLA, 2018).

Table 6 - Number and proportion of papers for each research topic.

Topics	Number of papers	Proportion (%)
ICT applications	18	20
e-Distribution	17	19
e-Business	12	13
e-Commerce	11	12
e-Marketing	11	12
Productivity	11	12
Innovations	5	6
Other topics	5	6

Source: Prepared by the authors.

The ICT incursion in the tourism industry has generated important changes in the different links of the value chain, with the **e-distribution** segment presenting the greatest transformation. Recently, criticisms are arisen regarding the theoretical approach to the issue of travel and tourism distribution from the traditional tourism channel approach, which has been understood within a managerial framework, appearing as a static, linear and isolated process, happening in distribution channels (JORGENSEN, 2017, p.312). According to Navío-Marco, Ruiz-Gómez, and Sevilla-Sevilla (2018) tourism distribution must be interpreted as a dynamic relational process of mediation, which occurs in networks of activity systems, rather than a linear process of economic exchange.

For Berné *et al.* (2015) ICTs have facilitated cooperation and exchange of information between the different actors, giving a greater participation to consumers and providing new management solutions, which affects competitiveness and the efficiency within the distribution system. Likewise, the use of ICT in the distribution processes of

tourist products have triggered verticalization (MACEDO; DA SILVA, 2016), and disintermediation of the sector (BUHALIS; LAW, 2008). Regarding verticalization, there has been a trend among tour operators to purchase travel agencies in order to enhance their market position (MACEDO; DA SILVA, 2016) and the Global Distribution System (GDS) go from being mere technology suppliers and venture into the sale of tourist products (BARRIO *et al.*, 2016), competing with their former clients.

Concerning to disintermediation, although the traditional channel represented by tour operators, and travel agencies, have managed to survive thanks to the GDS. The Internet gave way to the development and advancement of online travel agencies (OTAs), and metasearch engine, as well as, the appearance of disruptive market forces such as Airbnb, HomeAway, HouseTrip or Uber, among others, that are part of sharing economy. New virtual platforms developed by travel agencies, metasearch, tour operators and independent providers have allowed consumers to access information in real time related to the availability and rates of tourist products, facilitating the purchase process through any mobile device, and with various payment alternatives. This translates into an alteration of the distribution structure in the sector, a change in the power relationships and a modification in the tourism productions process and products-services (COLOMBO; BAGGIO, 2017; BERNÉ *et al.*, 2015).

Regarding to **e-business** topic, research has focused on the study of the determinants for its adoption, the effect on the competitive advantage (OLIVEIRA; MARTINS, 2010), critical success factor (LIN, 2017; MARAIS; DU PLESSIS; SAAYMAN, 2017) and the development of capabilities as the core of the business strategy (ABU-MUSA, 2004). Indeed, the study developed by Vladimirov (2015) states that joined the competitive pressure and gaining competitive advantage, the perceived benefits and obstacles of e-business, technology readiness, technology integration, firm size, and trading partner collaboration, are the most relevant factor to characterize the appropriation and use of the e-business.

Benitez *et al.* (2018) point out in their research, several e-business technology services that any firm can have, amongst them, they stand out; website, online catalogue, site map, search engine, bulletin subscription, e-mail, discussion forum, online calendar/agenda, documents repository, invoice system, shopping cart solution, payment system, website advertising, Intranet, SCM, shareholder solution, social media, frequently asked questions and customer loyalty solution, among others. On the other hand, Boundless (2015) adds that e-business includes CRM, business partnerships, e-learning, and electronic transactions within an organization.

Although there is no single definition for e-business term and each author includes within the concept different activities of the tourism value chain and various technological tools, there is a tendency among scholars and professionals to adopt the term e-tourism as a synonym of e-business applied specifically to the travel and tourism industry. For Buhalis and Jun (2011) e-tourism includes all functions related to business management, information systems and tourism management, for example, e-commerce, email marketing, electronic production, as well as the electronic strategy, electronic planning and management for all sectors in the tourism industry.

Hua (2016) elaborates a literature review related with the **e-commerce** performance and its impact in tourism, industry identifying three types of benefits according to the model proposed by Abou-Shouk *et al.* (2013); marketing and competition, support strategy and development and business efficiency. Regarding marketing and competition benefits, e-commerce can enable efficient collaboration between stakeholders (BOURGOUIN, 2002; KIM, 2006), improved organization image

and reputation (LIAO; PAR, 2006), customer loyalty (RUIZ-MOLINA; GIL-SAURA; MOLINER-VELÁZQUEZ, 2010), operating efficiency and performance (COHEN; OLSEN, 2013; LAW *et al.*, 2014) and competitive advantage (KIM *et al.*, 2009; COBANOGLU *et al.*, 2013; HUA; MOROSAN; DEFRANCO, 2015; ABOU-SHOUK *et al.*, 2016).

In term of support strategy and development e-commerce adoption was shown enhance a firm's capability to penetrate international markets (JIN, 2007; MACGREGOR, 2004), strengthens firms' capability of service customization (PEASE; ROWE, 2005), increased and easier access to information and knowledge (MOROSAN, 2014), and improving communications with customers, suppliers and partners (QUAYLE, 2002). Finally, e-commerce leads to improvements in the operational and internal efficiency (BUHALIS, 2003; MILLS *et al.*, 2010; CHATHOTH; LAW, 2011), better business performance (HEUNG, 2003), improved distribution channels and reduced operation costs (ABOU-SHOUK *et al.*, 2013) and improved supply chain efficiency (QUAYLE, 2002).

Another of the topics in the literature is that the **productivity**, defined as the ratio of current output to input over a period (SIRIRAK *et al.*, 2011). The existence of several articles in this topic is the result of a significant number of authors have used the term productivity and competitiveness without distinction. However, it is important to note that authors such as Porter (1991) point out that competitiveness is determined by the productivity with which a nation, region or cluster uses its natural, human and capital resources. Therefore, competitiveness is based on the ability of an industry to generate and adopt technology innovations that translate into an improvement in productivity. Table 7 includes some findings in the literature that show the relationship between productivity, competitiveness and ICT in the tourism industry.

The recent revolution in **e-marketing** has notably affected the performance (EL-GOHARY, 2012; EID; EL GOHARY, 2013; SHEIKH; SHAHZAD; ISHAQ, 2017) and competitiveness advantage of business (DAY; BENS, 2005; TEO, 2007). In the literature, special importance has been given to the determinants in the adoption of e-marketing, given the effect of technological tools to organize, automate, and synchronize sales, marketing, customer service, and technical support in tourism industry (SINGH; RATHORE, 2018). Authors like El-Gohary (2012) identify the owner skills, available resources, organizational culture, organization size, adoption cost, perceived ease of use, and perceived compatibility are the most important factors affecting the adoption of e-marketing.

Likewise, the market orientation is considered a crucial success factor for business performance, and can enhance other marketing resources, such as e-marketing and further increase performance via these resources (TSIOTSOU; VLACHOPOULOU, 2011). Market orientation emerges as a business strategy based on the use of the market information and its adopting enables a company to develop a sustainable competitive advantage (KOHLI; JAWORSKI, 1990; NARVER; SLATER, 1990), since it is a strategy difficult to copy by its competitors. Polo, Frías and Rodríguez (2011) find empirical evidence, which allows determining that the use of ICT is a positive antecedent of great importance for the adoption of a market orientation approach among smaller service enterprises.

There is a trend towards studying the effect of various digital marketing tools on tourism. Jorge *et al.* (2018) to analyze the influence of five relevant digital marketing tools (website, e-mail, mobile devices, booking and, electronic word-of-mouth (WOM)) on low-density tourism regions success, measured through destination image, tourists'

satisfaction and loyalty. The e-marketing has gained special importance because of the possibility of new tourist destinations through innovations that emerged with the development of ICT, increases the productivity and efficiency of hotels' marketing efforts, allowing hospitality companies to reach their customers directly in order to offer those promotions and sales (DI PIETRO *et al.*, 2012, p.61).

Innovative activity is considered one of the critic factors of the firm's competitive position, and in ensuring the long-term growth and competitiveness of national tourism sectors (DIVISEKERA; NGUYEN, 2018). Innovative solutions are the key to the promotion of tourist regional development and ICT appear to offer excellent opportunities to tourism development (KATSONI; VENETSANOPOULOU, 2013, p.36). The increase in competitive precision between companies and tourist destinations, changes in the consumption habits of tourists and emergence of new business models based on ICT are seen as major factors stimulating investment in innovation and ICT (PORTER, 1993; BUHALIS, 1998; GARRIGOS *et al.*, 2012). For Mihalič and Buhalis (2013) ICT impact and specially the Internet in the tourism industry allows the firms to introduce constant innovations in terms of technological advancements in order to be able to offer differentiated and value-added products.

The interest by marketers, producers, and academics in the study of the impact of **online social networks** in the tourism industry has been increasing in recent years due to its potential in creating value. Among the main arguments cited by the authors explaining the importance of online social networks in improving the competitive advantage in the tourism industry, it is remarkable,

- 1 Social networks have become a source of information that can strongly influence potential clients (PALACIOS-MARQUÉS; MERIGÓ; SOTO-ACOSTA, 2015; BANERJEE; CHUA, 2016)
- 2 If online social networks are used to create and manage new knowledge, it will help organizations to face the challenges of the competitive environment (PALACIOS-MARQUÉS; MERIGÓ; SOTO-ACOSTA, 2015).
- 3 Have a positive impact on innovation capacity, since knowledge obtained from the customers can be used to improve processes or to create new products (ATRAS; LYKOVA, 2013).
- 4 Offer organizations the opportunity to join a conversation with millions of customers, knowing who is talking about their brand and their products or services, identifying positive and negative comments (PALACIOS-MARQUÉS; MERIGÓ; SOTO-ACOSTA, 2015).
- 5 Using online social networks in a business model that prioritizes innovation, this technology can become a source of value creation, since these technologies encourage underlying innovations to emerge and spread (XIANG; GRETZEL, 2010).

Within the broad deployment of ICT in the tourism, industry has emerged a new conceptual model called SoCoMo marketing, a combination of social media (So) and context-aware marketing strategy (Co) on mobile devices (Mo) used for adding value to the experience of tourists dynamically and allow them to leave a destination with a positive impression (BUHALIS & FOERSTE, 2015, p.2). Abowd *et al.* (1999) define context as any information that can be used to characterize the situation of an entity (person, place, or object that is considered relevant to the interaction between a user and an application). Context-based marketing suggesting products and services to meet users' preferences and needs (FESENMAIER *et al.*, 2006; YU; CHANG, 2009), facilitating the taking of decisions for tourist, as they are usually unfamiliar with the local environment

and conditions.

SoCoMo marketing incorporates information from the user, but also from a very wide range of information and product suppliers, especially through big data collected in a smart destination framework; information in social media, through which consumers participate, express sentiments, opinions, likes and dislikes. They reveal rich in sights in their internal context; information generated within the consumers' external context that surrounds them and their mobile device; and information generated in the mobile device itself, which may store information, preferences, passwords, allergies, etc. The mobile may also document aspects of the mobile user behavior (BUHALIS; FOERSTE, 2015). The SoCoMo model revolutionizes destination marketing, since the tourist destinations and the firm needs dynamic communication with individual consumers before, during and after their travelling experience (NEUHOFFER; BUHALIS; LADKIN, 2012).

4.3 Main findings in the literature

As mentioned above, found several studies that dealt with the definitions of competitiveness and productivity as if it were the same question, which requires a more detailed analysis of these studies to determine what really, wanted the researchers with their studies. However, insofar as the issue was gaining greater importance in the academic world, this problem was overcome. The results of investigations shed four positions toward the issue, the first authors who consider that ICT and competitiveness have no relationship, second those who believe a relationship negative between these two variables, thirdly those who consider ICT affect positively competitiveness through other factors, and finally those who consider that there is a positive relationship. Thesis has gotten stronger in the last few years.

The discussion about the relationship between competitiveness and ICT, reached its peak when Carr (2003; 2004; 2005), based on the productivity paradox of Solow (1987), characterizes it as fuzzy. Suggest that, these is a basic product like electricity or phone, and therefore, cannot be considered a source of competitive advantage since it does not fulfil the requirements of the competitive advantage concept. The reasoning of Carr is understandable since an overview of terminology shows that scholars and practitioners understand and use the subject differently, being the main reason for the negative feedback Carr's seminal paper received. Before the strong criticisms, Carr (2004) defends himself arguing that the subject of his paper was only IT as technology (software and hardware), but not the information that flows through the technology or the people using this technology (BREZNIK, 2012).

Authors such as Berndt and Morrison (1995) and Morrison (1997) states that the cost of investment and maintenance in ICT is greater than the real effect it generates in increasing the productivity of companies. Some authors even point out that investment in ICT generates a negative effect on productivity (ROACH, 1991; BRYNJOLFSSON, 1993; SMITH-DAVID; GRABSKI; KAWASANA, 1996; MIHALIČ, 2007) and the creation of competitive advantage for firms (WARNER, 1987). One of the reasons that can be cited and that explains the negative results is the lack of measuring instruments that would allow measuring the real effect of ICT on productivity and competitiveness (MIHALIČ, 2007). Likewise, we can mention the period used in the studies, not knowing that the effect can occur in the medium or long term and finally, due to poor management or underutilization of technology in the company.

On the other hand, some authors do not see ICT as an independent competitive factor (MIHALIČ; BUHALIS, 2013); its impact on the tourism industry is indirect and is

influenced by human, organizational and environmental factor among others (ELLY; BOTER, 2011). Therefore, for ICT to have an impact on productivity and competitiveness in the tourism industry, it is necessary to invest in other assets such as human capital. (TAVITIYAMAN; QIU; QU, 2012; SKORUPINSKA; TORRENT-SELLENS, 2015), work organization, knowledge and technology creation, institutions (SKORUPINSKA; TORRENT-SELLENS, 2015), organizational learning (TIPPINS; SOHI, 2003), branding, IT innovations, niche marketing and advertising, and price tactics (TAVITIYAMAN; QIU; QU, 2012).

There are innumerable advantages that are exposed in the literature, resulting from the appropriation of ICT in the tourism industry. Within the main effects in organizational, and production aspects we find: allows the product's differentiation, improves the products and services quality (MIHALIČ; PRANIČEVIĆ; ARNERIĆ, 2015). Enhance its core competence of the organization (RAVICHANDRAN; LERTWONGSATIEN, 2005). increase efficiency (OLIVEIRA; MARTINS, 2010; BILGIHAN *et al.*, 2011; SIRIRAK; ISLAM; KHANG, 2011; HUO *et al.*, 2015; ŠERIĆ; SAURA; PRANIČEVIĆ, 2016; ASSAF; TSIONAS, 2018), facilitates information-sharing (ŠERIĆ; SAURA; PRANIČEVIĆ, 2016) and provide decision support (BILGIHAN *et al.*, 2011).

In the financial aspects it stands out the increasing profitability (OLIVEIRA; MARTINS, 2010), optimizing and reduction cost (BILGIHAN *et al.*, 2011; HUO *et al.*, 2015; ŠERIĆ; SAURA; PRANIČEVIĆ, 2016; ASSAF; TSIONAS, 2018), allow offering more competitive prices (RAMOS; RODRIGUES; RODRIGUES, 2015) and inventory reduction (OLIVEIRA; MARTINS, 2010). Finally, in the market aspects can be noted: enhancement of brand image (BILGIHAN *et al.*, 2011), sales increase (OLIVEIRA; MARTINS, 2010), customer relationship enhancement and loyalty (OLIVEIRA; MARTINS, 2010; BILGIHAN *et al.*, 2011), guest satisfaction (SIRIRAK; ISLAM; KHANG, 2011; HUO *et al.*, 2015; ŠERIĆ; SAURA; PRANIČEVIĆ, 2016) and increased market share (OLIVEIRA; MARTINS, 2010; SIRIRAK; ISLAM; KHANG, 2011; HUO *et al.*, 2015).

Other advantages of the use of ICT in the tourism industry that the literature points to is, the contribution to innovation processes (BUHALIS; LAW, 2008; JOLLY; DIMANCHE, 2009; ALDEBERT; DANG; LONGHI, 2011; BERNÉ *et al.*, 2015; HUO *et al.*, 2015; MIHALIČ; PRANIČEVIĆ; ARNERIĆ, 2015; DAULATKAR; HUA, 2016; SANGLE, 2016), to add value to the transactions (BERNÉ *et al.*, 2015), improve performance (SIGUAW; ENZ; NAMASIVAYAM, 2000; PORTER, 2001; SIRIRAK; ISLAM; KHANG, 2011; MIHALIČ; BUHALIS, 2013; BERNÉ *et al.*, 2015; HUO *et al.*, 2015) and is a key determinant of competitiveness in this sector (MIHALIČ; PRANIČEVIĆ; ARNERIĆ, 2015; FUENTES-BLASCO; MOLINER-VELÁZQUEZ; GIL-SAURA, 2017; ILIĆ; NOKOLIĆ, 2018).

Despite the contradictory results, there is no doubt that ICT has played a fundamental role in the development and transformation of the tourism industry (ASSAF; TSIONAS, 2018). The most important monitors and rankings of competitiveness that measure development include ICT within their measurement models, which suggests that the discussion around the relationship between ICT and competitiveness, at least at the macroeconomic level, has been resolved.

Table 7 - Relation between ITC and competitiveness

Effect	Description of Findings
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Direct and Positive Effect	<p>The use of modern technology in tourism has been expanded to provide a wider range of products and services to tourists all over the world and is a key determinant of competitiveness in this sector (ILIĆ; NOKOLIĆ, 2018). Digitalization is changing the structure of the industry by altering barriers to entry, facilitating price transparency and competition, revolutionizing distribution channels, optimizing costs and improving production efficiency (ASSAF; TSIONAS, 2018).</p> <p>In tourism, the adoption of ICT and variables concerning firms' links with suppliers have been recognized as key determinants to improve companies' competitiveness (FUENTES-BLASCO; MOLINER-VELÁZQUEZ; GIL-SAURA, 2017).</p>
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Table 7 - Relation between ITC and competitiveness (Continued)

Effect	Description of Findings
Direct and Positive Effect	<p>Firms invest in IT to build process capabilities and increase their competitiveness (CHEN <i>et al.</i> 2015; CUI <i>et al.</i>, 2015; WANG; CHEN; BENITEZ, 2015; AJAMIEH <i>et al.</i>, 2016).</p> <p>Competitiveness depends on the quality of ICT-related innovations (HUO <i>et al.</i>, 2015; DAULATKAR; SANGLE, 2016; HUA, 2016).</p> <p>Travel agents are among service providers for whom their integration of ICT and Internet technological capabilities could be the best marketing device and a potential promoter for enhancing their competitive positioning in the tourism sector (ZAIDAN, 2016).</p> <p>The implications of the ICTs for tourism competitiveness and promotion are globally recognized and have deeply modified the structure of the industry (IYER; DEY; CHAKRABORTY, 2015).</p> <p>ICT is becoming an important part of the product's differentiation and quality, and this is an important factor in a hotel firm's business and competitiveness (MIHALIĆ; PRANIČEVIĆ; ARNERIĆ, 2015).</p> <p>Many advantages of ICT adoption have been pointed out, such as cost reductions, improved customer satisfaction, increased market share, improved performance among employees, greater operating efficiency and the achievement of competitive advantages (HUO <i>et al.</i>, 2015).</p> <p>Travel agencies can strengthen relations with their suppliers through ICT, confirming the existence of a positive relationship between increased use of technologies and business performance (BERNÉ <i>et al.</i>, 2015).</p> <p>ICT has become critical for organizations, with many studies highlighting the importance of this technology for the economic growth and competitiveness of firms (LIU <i>et al.</i>, 2014).</p>
Direct and Negative Effect	<p>The impact of ICT in the productivity is negative (MIHALIČ, 2007).</p> <p>There is evidence of a negative relationship between ICT investment and productivity, called the IT productivity paradox (BRYNJOLFSSON, 1993)</p> <p>Strategic IT has a negative effect on competitive advantage or performance (WARNER, 1987).</p>
No Connection or Effect	<p>Empirical studies have shown inconclusive results in assessing the impact of ICT in competitiveness of firms (WU; CHEN, 2014).</p> <p>There is still no clear evidence about the circumstances under which the ICT help to generate competitive advantage (PICCOLI; LUI, 2014).</p>

Some scholars argue that IT resources such as hardware or software cannot be a source of competitive advantage since they can be copied easily (BREZNIK, 2012).
 There is no significant impact from ICT investments on firm's value, firm performance and its competitive advantage, generally supporting the ICT paradox theory (CARR (2003; 2004); LEE; CONNOLLY, 2010).
 The relationship between ICTs and competitive advantage and performance is still unclear (BUHALIS, 2004).
 ICT do not act alone in affecting productivity, but require other factors such as human capital, work organization, knowledge and technology creation and institutions (SKORUPINSKA; TORRENT-SELLENS, 2015).

Table 7 - Relation between ITC and competitiveness (Continued)

Effect	Description of Findings
Contingent Effect	<p>There is more evidence that some authors do not see ICT as an independent competitive factor (MIHALIC; BUHALIS, 2013). A single resource cannot create competitive advantage. Rather, it is the combination of competitive resources – branding, human resources, IT innovations, computer reservation systems, niche marketing and advertising, and pricing tactics – that can increase a hotel's capabilities and improve performance (TAVITIYAMAN; QIU; QU, 2012). The implementation of IT and its effects are frequently indirect. Investments in IT usually require additional inputs (and costs), for instance in human resources, and these extra costs and efforts usually create doubts about the (short-term) profitability of IT (BREZNIK, 2012).</p>

Source: Prepared by the authors.

As ICT and the way of doing business has evolved, new fields of application of new technologies found in different areas of the organization, which has allowed professionals and researchers identify new generators of competitiveness factors, as it has been cited in the previous paragraph. What is certain is that the deepening of the development of the cognitive society will clear the doubts that persist about the real effect of ICT on competitive advantage in the tourism industry. Finally, these technological tools have potential for the continuous transformation of firms and become an indispensable component for the development of the tourism industry.

5 RESEARCH METHODOLOGIES AND MEASUREMENT APPROACHES HAVE BEEN USED

Once collected the information from the research methodology applied in each of the 90 papers, we find 11 exploratory studies, 59 descriptive and 20 correlational. As regards the descriptive studies, found that 47 papers correspond to literature review and 12 papers developed by the case study method. With regard to research correlational we find statistical techniques within five linear regression analysis, four multiple regression analysis, three logistic regression analysis, six Structural Equation Model (SEM) and two factorial analysis Also we found three papers made with the model Data Envelopment Analysis (DEA).

The procedure of bivariate correlations was used to measure the degree of

dependency between variables, especially through the quantification of the linear Pearson and Spearman correlation coefficients. In addition, three studies used the Alpha Cronbach's to measure the reliability of the measurement instrument. The Kaiser-Meyer-Olkin (KMO) test was used to measure the suitability of the data for the factor analysis. Given the use to the Analysis of variance (ANOVA), Analysis of Covariance (ANCOVA) and Duncan's multiple range test. Among the programs used for the analysis of correlation, eleven used Statistical Package for the Social Sciences – SPSS, occupying the first position. Other programs are also used as LISREL, AMOS, DEA Frontier, STATA and EQS Software.

6 CONCLUSIONS AND LIMITATIONS

The incursion of new technologies in the business world has aroused the interest of researchers and practitioners to know if the ICT can be a source of productivity and competitiveness in the tourism industry. This paper is intended, through a SMS methodology, to determine the relationship between ICT and competitiveness in the tourism industry. 90 papers published between the years 1995 and 2018 of the 791 found fulfilled the inclusion criteria were selected and analyzed. The main conclusions of the different authors in relation to the two constructs are contradictory and can be grouped into four major categories; direct positive relationship, negative relationship, no relationship and positive relationship through other factors. However, in recent years there has been a significant increase either in the evidence that indicates a positive relationship between ICT and competitiveness, directly or through other factors (TAVITIYAMAN; QIU; QU, 2012).

From the macroeconomic point of view, the relationship between ICT and competitiveness of the tourism industry is indisputable. The different monitors of global competitiveness include within their models an important number of variables related to ICT. However, at a microeconomic level, the discussion has not yet been resolved since the adoption of technology or any other kind of resource can generate dissimilar results in different companies given the characteristics of each firm. Nevertheless, it is clear that, to get the greatest impact on the productivity, and competitiveness of firms, and destinations, the application, and use of ICT. Must be accompanied by investment in training of human capital, decentralization of decision-making, innovation, to know and meet the client needs, the market orientation, tactics of pricing, and other measures, which take full advantage of the technological infrastructure.

Therefore, the constant advance of ICT and the greater presence of these in the different links of the value chain of the tourism industry make ICT an essential tool for companies in the sector, especially when tourism has been characterized as an information intensive industry (COX *et al.*, 2009). Administrators of tourist organizations and tourist destinations should be clear that ICT is a tool that allows you to generate an improvement in productivity and competitiveness, but this should be managed in a creative and innovative way. It cannot ignore that linked to Internet technologies, offer important returns related to the increase in customer satisfaction, and sales, reducing costs and inventories, increase the productivity, improvement in efficiency in marketing strategies, and facilitates the positioning of the tourist destinations.

The development of Web-based technologies raised new challenges to the tourism industry to adapt changes in the consumption habits of tourists. Internet plays a new role

as intermediary, by overcoming the traditional role of tour operators and travel agencies and providing tourist the possibility to buy several tourist products and services by themselves (BUHALIS; LAW, 2008, p.611). It is imperative that any company that wants to survive in the current business context required including within its strategic plan's development, appropriation and use of ICT in different key business processes. Innovation has been identified as one of the most important factors in generating and sustaining competitive advantage and ICT, they are, therefore, an important tool in the generation of innovations in product, services, processes, etc. (CASALINO *et al.*, 2015).

Within the limitations of the study, it can be mentioned there are several factors that can affect the results of a SMS, among them the time horizon and the search terms. With the aim of avoiding the omission of important articles for the study, it took seven of the most important databases of scientific literature relevant to the topic of study. Equally, was conducted manual search of articles cited in the bibliography found, which were subject to the criteria of inclusion and exclusion defined previously. The period was extended as well as the exclusion; criteria were minimized as much as possible in order to include the largest number of articles. Future research should be aimed at identifying the factors and conditions in which investment in ICT translates into increases in productivity and competitiveness in tourism companies. Structural equation models are a useful tool in this purpose, since they allow to quantify the variables that measure the relationship between ICT and competitiveness.

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