Journal of
Hospitality and Tourism Technology

New Technology and Tourism Industry Innovation: Evidence from Audio-Visual Patented Technologies

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Abstract

Purpose - Patenting behaviour in the tourism sector has received little academic attention due to a wider belief that innovation in tourism commonly involves improving the services in ways that are hardly patentable. The current study aims to address this oversight by focusing on patent analysis as means to evaluate the innovation trends in tourism.

Design/methodology/approach - Building on an analysis of historical series of patents worldwide from 1996 to 2016, this paper explores the trends in the tourism sector by focusing on audio-visual technologies. The study used an evaluation of the 8,785 emerging patents, in terms of co-occurrences, applying hierarchical cluster analysis, factor analysis and multidimensional scaling.

Findings - The findings suggest that there is a gradually increasing interest in innovation in tourism, which is growing faster than most of the other sectors explored here such as transportation and pharmaceuticals. The outputs also reveal the inventive effort of tourism industry in new technologies for developing utility models for tourists.

Originality/value - The study contributes to tourism theory and practice by offering an overview of current/future applications of new technologies in tourism along with future trends, and mapping the main areas that these technologies might affect.

Keywords: audio-visual technology; patent analysis; tourism marketing; new technologies; innovation management

Introduction

Innovation is playing an increasingly important role in the service sector (Tajeddini *et al.*, 2020) and is particularly critical for the tourism industry, which is characterized by growing innovation research (Divisekera & Nguyen, 2018; Rodriguez-Sanchez *et al.*,

2019; Hjalager, 2010; Valenca *et al.*, 2020). The need to be innovative is strongly

linked to the existence, sustainability and growth of tourism operators that intensively

compete in a highly globalized marketplace (Backman *et al.*, 2017). Moscardo (2008,

p.5) defines innovation as a 'dynamic capability based on patterns of thinking and

action that allows an organisation to regularly modify the way it operates to improve its

effectiveness.' Innovations in tourism not only are vital cement of the sector but reshape

competition since they influence tourist satisfaction and behaviour (Truong *et al.*, 2020)

and expand the industry's boundaries (Wang *et al.*, 2016).

A number of scholars, however, have highlighted that rigid innovation research in

tourism is lacking in general and called for additional empirical evidence generated

through quantitative studies rather than a case-by-case approach (Divisekera & Nguyen,

2018; Hall & Williams, 2009; Succurro & Boffa, 2018), as the latter fails to provide

rigid classification of the critical areas of development in the industry (Pantano *et al.*,

2017). Recent studies justified the still scarce research on innovation in tourism as

prompt by the adoption of approaches developed for manufacturing industries that are

inadequately applied in tourism (Valenca *et al.*, 2020).

Such studies called for further investigations in understanding how tourism might

benefit from innovation (Romao & Nijkamp, 2019), via longitudinal research aiming to

better capture the dynamic and complex nature of the innovation process specifically in

the tourism industry (Rodriguez-Sanchez *et al.*, 2020; Williams *et al.*, in press; Singh *et

al.*, 2020). Similarly, Succurro and Boffa (2018) have argued that the patenting

behaviour in tourism has received little academic attention and attributed this lack of

research to a wider belief that innovation in tourism commonly involves improving the

services (Truong *et al.*, 2020) in ways that are hardly patentable (Hall & Williams,

2008), leading scholars to assume that patenting is scarcely relevant in the tourism

industry. Also, studies on innovation in tourism mainly focused on processes,

stakeholder involvement and management, role of frontline employees, context

configuration, knowledge, technology and eco-innovations (Baradarani & Kilic, 2018;

Ozseker, 2019; Sundströma *et al.*, 2017). The innovation push as such has been

evaluated so far via an analysis of technologies already adopted, without detailed

predictions of future trends or their impact.

The current study aims to address these research gaps by focusing on patent analysis as

means to evaluate the innovation trends in tourism. In other words, it explores the

relationship between technology and tourism industry innovation, by providing a

concrete measure of the innovative force facing the sector. A patent analysis approach is

specifically efficient in the exploitation of a large amount of data, allowing for the

identification of patterns and prediction of future trends (Han & Shin, 2014; Pantano *et

al.*, 2018), and it is based on bibliometric analysis considered relevant also for the

tourism industry (Teixeira & Ferreira, 2018). The focus of this research is on the audio-

visual domain as the one which might have the highest impact on the tourism industry,

given a general consensus in the literature that tourism is a highly visual experience

(Terzidou *et al.*, 2018). The study contributes to tourism theory and practice by offering

a comprehensive understanding of current and future applications of new technologies

in tourism along with future trends, mapping the main areas that these technologies

might affect. Such findings would be beneficial to tourism managers and marketers, in

their attempt to monitor technological changes and understand the innovative forces to

maintain competitiveness (Divisekera & Nguyen, 2018). Uncovering the particularities

of innovation activities and their impacts also has wider implications for tourism destinations worldwide (Ozseker, 2019).

Literature Review

Innovation is considered critical for the survival and development of service providers (Agarwal & Dev, 2003). To this end, many recent studies have investigated the best business strategies to enable firms to overcome market turbulence and cope with the environmental challenges (Senbeto & Hon, 2020). Indeed, market forces and technological advances are making the management of and strategies for innovation more prominent and essential in all functions of modern business across various sectors (including tourism), attracting the attention of academics and practitioners in the field (Nieves & Quintana, 2016; Pantano *et al.*, 2018; Pizam, 2017; Williams *et al.*, in press). For Hjalager (2010) innovation in tourism can take many forms and shapes due to the sector's inherited characteristics including intangibility, inseparability, and perishability. The same characteristics, however, pose challenges in securing legal protection of intellectual property and measuring innovation (Malik *et al.*, 2020). Service organizations are challenged by fluid external environments, which force them to set innovation at the core of their competitive strategy (Baradarani & Kilic, 2018; Nieves & Quintana, 2016).

Service innovations, as opposed to product innovations, are commonly incremental improvements on current services (Tajeddini *et al.*, 2020). Such improvements often enhance customer service experience, add value to the various stakeholders including customers, employees and owners and increase the capacity of the business to deal with the uncertain environment (Sampson, 2012; Tsai *et al.*, 2016; Wang *et al.*, 2016).

Tourism business operators, destinations, and local governments as such are fully aware of the need to adopt new and more innovative policies for tourism management and marketing (Ozseker, 2019), while taking into consideration the different risks involved in each stage of the innovation process (Williams *et al*., in press.; Singh *et al*., 2020). Digital technology is gradually replacing traditional marketing tools leading to fundamental changes in marketing practices before, during and after a tourist trip (Oh *et al*., 2004). Destination managers and marketers are now widely using digital technologies before the trip to provide travel information through a vicarious experience of the destination to shape potential tourists' destination image and to allure them to visit the destination (Huang *et al*., 2013; Hernández-Méndez *et al*., 2015). Similarly, 3D virtual worlds have emerged for commercial activities including information dissemination, advertising and sales transactions (Barnes, 2011). For Williams (2006), virtual reality technologies assist tourism marketers in creating an experience that integrates meaning, perception, consumption and loyalty. However, the source of innovations to be adopted is considered a critical area of research in service innovation in general, with still limited evidence in tourism, in particular (Figueuredo Moreira *et al*., 2020).

Additionally, marketing innovations support tourists while at the destination by providing a) customized and detailed information (see for example the mobile app of Regents Street, London-UK to support the tourism experience in the shopping street); and b) opportunities to interact with the chosen accommodation establishment (see the chatterbot function of Booking.com). Similarly, new technologies support virtually exploring destinations and attractions providing better onsite experiences (Hunter *et al*., 2015; Jung *et al*., 2015) (i.e., by focusing the camera of a device on a particular object,

the display will show additional information such as closest places, key things to do,

history, etc. facilitating "interaction" with the place).

Such innovations have been particularly appreciated in the case of

historical/archaeological places, where augmented reality allows tourists to better

understand the original state of the place with emphasis on buildings and attractions that

are no longer accessible (Giglio *et al*., 2015). Third, innovations in digital marketing

enable sharing opinions, reviews and feedback as well as access others'

opinions/reviews through social media (see the official Facebook page of cities such as

New Orleans in US). This is relevant nowadays with the active involvement of tourists

in various social media platforms, and thus the role of the latter in shaping the image

other people are having of tourist destinations (Tamajon & Valiente, 2017; Giglio *et al*.,

2019).

Overall, the increasing integration of innovative technologies allows the development of

new efficient tourism management and marketing models, where the traditional

activities are supported by smart technologies to create and deliver services in an

entertaining and efficient way (Kim & Canina, 2015; Gretzel *et al*., 2015; Xu *et al*.,

2016). Previous studies on innovation in tourism have mainly focused on smart tourism

in terms of smart experience, smart business ecosystem (Gretzel *et al*., 2015) and smart

destinations and attractions (Wang *et al*., 2016; Wei *et al*., 2017). Considering the

technology management approach, this has been explored as the effect of the

introduction of smart technologies on tourist decision making process (Yoo *et al*., 2017;

Kuo *et al*., 2017), and tourism information services (Li *et al*., 2017). However, the

tourism industry still needs further investigations on tourism innovation, since the

tendency for technological experimentations associated with an excessive level of over-optimism and over-confidence might lead to failure in the sector (Williams *et al.*, in press.). This study aims to address this oversight by investigating the technology push in tourism industry along with the importance of technology and innovation management strategy for tourism, by focusing on patent analysis of a particular kind (audio visual) of innovative technologies.

Research Methodology

Data Collection

Research on innovation has evaluated the patents due to their trait of effectively reflecting technological innovation and synthetizing the evolution of technology in a certain area of interest (Pantano & Pizzi, 2020). In particular, patents are documents describing the technical features of an invention, criteria of originality, market attributes, inventor name, technical feasibility and commercial value (included in the patent description text).

Previous studies focusing on patent analyses in other fields mainly used bibliometrics to identify the innovation trends, i.e., through the evaluation of the number of patents per year and text mining (Lee *et al.*, 2011). This approach allows the exploitation of a large amount of historical data (i.e. number of patents), which can be explored to identify patterns and predict future trends. The analysis of bibliometrics could also support the tourism industry to investigate the emergence of granted patents (Teixeira & Ferreira, 2018).

We followed Pantano and Pizzi's (2020) approach, and collected the patents referring to

tourism industry through the platform Orbit, which is a comprehensive database of all granted patents, by the query to select all the patented innovation related to a certain keyword in a specific period of time. We limited the selection to the patents including the words "tourism" or "tourist" in the title and/or abstract, for a period between 1996 and 2016. This period was considered suitable to provide a good overview of patent development over the last 20 years. Among the 15,048 patents identified belonging to different domains (i.e., organic and fine chemistry, chemical engineering, transport), the audio-visual domain was selected as the one with the highest impact on; and of highest importance to tourism. The filtering process (i.e., including 'tourism' or 'tourist' and the year period) resulted in finally obtaining 8,785 patents. Among them, 4,237 are still 'alive' while 4,548 have expired (and none renewed). When building the initial dataset for each patent the following were considered: patent number, patent title, patent abstract, application date, acceptance date, assignees (patent owners) and country.

Data analysis

The first analysis consisted of the investigation of occurrences (the most frequent words). The platform Orbit allows conducting this type of analysis by evaluating the number of occurrences of each word (frequency analysis) and schematically reproducing the results in a word graph (see Figure 2 in Findings), in which a larger size of a word font implies higher frequency value of that word.

WordStat software was used to further explore the content of each patent and understand which aspect of the tourism industry might affect. To this end, the software allows executing several content analyses applying different techniques based on factor analysis. Secondly the most frequent topics and phrases were extracted (through a factor

analysis based on varimax rotation, see Table 3 in Findings), as the identification of

idioms and themes recurrent in the text corpus (patent description). Thirdly, the co-

occurrence analysis allowed identifying the most recurrent groups of words

(occurrences), better depicting the relationships among words, which were then

graphically presented through a proximity plot (Figure 3 in Findings).

Findings

The first stage of analysis encompassed the evaluation of patent numbers per year

across the studied period. An examination of the distribution of audio-visual patents in

tourism between 1996 and 2016 revealed that the largest number of patents (about 105

patents on average per year) have been registered the years 2015 and 2016. In contrast,

the first four years of the analysis (1996-1999) there were about 10 or fewer patents per

year, showcasing the limited impact new technologies have had at that time on tourism.

The new millennium marks a positive change in the number of patterns as numbers

started gradually increasing, with more than 20 patents per year on average being

registered from the year 2000 onwards, with the exemption of the year 2002 (where

only 13 were registered). Figure 1 illustrates this growing trend in audio-visual patterns

in tourism and is in line with researchers' assertion that the development of internet and

digital tools has created several possibilities for innovations in tourism (Wang *et al.*,

2016). The study, however, is one of the few ones to explore innovation in tourism via

longitudinal data, facilitating a better understanding of the dynamic and complex

innovation process (Rodriguez-Sanchez *et al.*, 2020; Williams *et al.*, in press).

[Insert Figure 1 Here]

To better understand these results in the wider context and assess whether tourism is an innovation-driven industry, further analyses was conducted comparing audio-visual patterns in tourism and the total number of patents in general, considering the percentage growth per year by taking 2010 as the reference year. Table 1 presents the results of that comparison suggesting not only the presence of a positive trend in tourism audio-visual patents, but also that this trend is growing much faster than the total amount of patents, showcasing an increasing interest in innovation in tourism. These results challenge some researchers' perception which underestimate the current level of innovation research in tourism (Valenca *et al*., 2020), but echo Succurro and Boffa (2018) findings on patented innovation in the hospitality sector in Italy.

[Insert Table 1 Here]

To further inspect the level of interest in innovation in tourism, the percentage of growth of the tourism audio-visual patents was compared to the percentage of growth of other selected sectors including telecommunications, medical technology, pharmaceuticals, food chemistry, micro-structural, and nano-technology and transport. From Table 2 it becomes evident that tourism audio-visual patents registered have the second highest rate of growth after micro-structural and nano-technology, and they surpass well-known innovative sectors like food chemistry and telecommunications, further validating the classification of tourism as an innovation-oriented sector. This finding is surprising considering the recognised lack of empirical research documenting innovation in tourism (Rodriguez-Sanchez *et al*., 2020; Williams *et al*., in press; Singh *et al*., 2020; Valenca *et al*., 2020).

[Insert Table 2 Here]

The next step involved performing content analysis of the identified 4,237 patents'

abstracts. Orbit allows conducting this type of analysis by evaluating the number of

occurrences of each word (frequency analysis) and schematically reproducing the

results in a word graph (see Figure 2), in which a larger size of a word font implies

higher frequency value of that word. As it can be concluded from Figure 2, the

dominant terms included in the description of the patents (abstracts) are information,

device, tourist, system, module, guide, display, model and data. Of significant size are

also the terms body, spot, utility, screen, voice and image. These terms are in line with

the particular context of this study which focused on audio-visual patents in tourism.

More precisely, it appears that a larger volume of patents is aiming to improve the

provision of information for tourists regardless of the stage of the trip. Additionally, a

lot of them require the use of a particular device, that being a smartphone, digital guide,

etc., as the description of the patents included terms like screen, voice and image.

[Insert Figure 2 Here]

WordStat was used to evaluate the topics by conducting a factor analysis based on

Varimax rotation. During this process, all the factor loadings with values higher than a

certain value (in this case 10, meaning that a factor must be included in at least 10

different patents in our data set) were retrieved as part of the extracted topic.

Nevertheless, topic modelling using factor analysis might result in some words being

associated with more than one factor. From the results presented in Table 3 it can be

concluded that patents aiming at enhancing visitors experience are quite common

among the studied period, including equipment, sets and utilities related to attractions. Another proportion of patents are using the terms GPS, maps and positioning, being related to new technologies and applications that relate to locations such as navigators and guides. Visual is another key element included in the description of the patents, with words like camera, image, video and recording denoting that. Lastly, some patents appear to use more technical terms, being related to networks, power and microprocessors. Overall, the emphasis on tourism innovation seems to be customer centred, in contradistinction to the manufacturing industries where the focus is on the business processes and product development (Valenca *et al*., 2020).

[Insert Table 3 Here]

Subsequently, the phrases extraction exercise allows identifying the common phrases through the function phrase finder. Table 4 summarizes the 20 most frequent phrases/keywords by grouping the different words (keywords in order to give a sense to the concept). Table 4 also indicated terms' frequency weighted by inverse document frequency (TF. IDF) (see Humphreys & Wang, 2018 for the detailed tf.idf explanation); that is, the weighting is based on the assumption that: a) the more often a particular term occurs in a text, the more it is representative of its content; b) the more text in which the term occurs, the less discriminating it is. As it can be seen in Table 4, the highest number of patents is related to a utility model for tourists (*n = 524*), followed by scenic spot (*n = 358*), tour guide (*n = 238*) and display screen (*n = 218*). These findings imply that most of the patents in tourism marketing are of short to medium term (typical characteristic of a utility model) and provide tourist information usually through a display screen. These results are also in line with the outputs presented in Table 3.

[Insert Table 4 Here]

Finally, we performed the co-occurrence analysis, on all extracted words and visualized the results through a proximity plot (Figure 3). Analysis here was only limited to the cluster including the major number of words connected to each other. The results suggest that the terms 'tourist', 'information', 'guide', 'tour', 'device' and 'wireless' are centrally located and well connected with most of the others. Similarly, keywords such as 'display', 'screen', 'voice', 'scenic' are also quite relevant in describing audio-visual patents in tourism.

[Insert Figure 3 Here]

Discussion and Conclusions

Using an analysis of audio-visual patents in tourism, this study presents one of the first attempts to holistically analyse technical progress and innovation in the tourism field, while at the same time forecasting future trends. The findings of the study suggest that there is a strong interest in innovation in tourism, which is currently growing faster than most of the other sectors explored such as transportation and pharmaceuticals. This innovation trend, however, is in contradistinction to tourism innovation research which is still in its infancy (Divisekera & Nguyen, 2018; Succurro & Boffa, 2018). Positioned second only after nano-technology, tourism is the sector with the highest level of increase in number of patents (in terms of percentage growth per year), with a continuous increase up to the year 2016 when data were collected. This growth places tourism in the ascendant stage of the technology life cycle curve (Daim *et al*., 2006),

indicating that this trend will continue in the future. This is further supported by huge

investments in innovation in domains such as tourist experience and satisfaction, which

are forecasted to continue in the years to come (Mandić & Garbin Praničević, 2019;

Yeoman & McMahon-Beattie, 2019).

Theoretical Implications

This research, moving beyond a case-by-case approach (Pantano *et al*., 2017), extends

previous studies that have focused on the effects of new technologies on tourism (Kim

& Canina, 2015; Pizam, 2017), on the human antecedents of innovation (Tajeddini *et*

al., 2020), and on how innovation can be applied to the sustainable tourism

development context (Heslinga *et al*., 2019). The ability to generate potential future

scenarios is deemed critical for developing proactive strategies (Yeoman, 2012). In

particular, the results revealed: (i) the development of utility models to create value for

tourists; (ii) new systems to improve the scenic spot (landscape, attraction, etc.); (iii)

new systems for more innovative tour guides; and (iv) innovative interactive displays.

The key themes of patents identified such as those related to tourist guides and

information support the importance of understanding tourist decision making, electronic

word-of-moth communications (eWOM) and information search along with the

management of consumers' experience in tourism. Such findings also contribute to

current debates (see Hughes & Moscardo, 2019) on the effect innovation in tourism

could have in the future on many of the current jobs in tourism in a number of areas

such as tour guides or tourist information centres.

The study further contributes to the literature by providing empirical evidence of critical

areas for innovation in tourism along with the innovative forces affecting it, which

might push the tourism sector in the near future to be increasingly an innovation-oriented one (Pantano *et al*., 2017). Technological developments already available for tourism support this direction (Cai *et al*., 2019; Hughes & Moscardo, 2019), while from a futures perspective continuous innovation is much needed (Heslinga *et al*., 2019). The analysis of the actual patents granted offers an overview of the innovation that could be integrated in tourism in the near future. The study results clearly highlight the new technologies in which tourism practitioners should invest to enhance the tourism experience. Currently there is huge interest for technological innovation able to make the destinations smart and provide smart tourism experiences (Li *et al*., 2017; Mehraliyev *et al*., 2019; Yoo *et al*., 2017).

Practical Implications

The interest in the technologies improving information searching would assist managers in making decisions about investing in a certain innovation (Li *et al*., 2017; Jovicic, 2019), also at the destination level (Ozseker, 2019). Within this realm, recent research reveals that frontline employees have a key role to play, especially in the hospitality context (Baradarani & Kilic, 2018; Stylidis, 2021). Business operators in tourism should therefore seek for employees who are open to and familiar with new patents and services. A change in organisational culture and values is also a pre-requisite, with a stronger focus on customer value creation of delivering what customer expects (Jaaron & Backhouse, 2018). Through, therefore, a detailed analysis of patents in tourism, tourism managers can identify the current trends, understand the main areas affected by the inventive force and make suitable investment decisions, providing new tourist solutions (Pierdicca *et al*., 2019). Within this context, stakeholder identification,

involvement and management is deemed important for the innovation process to

succeed (Sundströma *et al.*, 2017).

Limitations and Directions for Future Research

Our analysis provides an overview of innovation in tourism by considering specifically

inventions in audio-visual that have been patented; a limitation of the study is that it has

excluded others that cannot. Thus, we encourage new studies to identify which kind of

patented innovations provided effective technological solutions in the tourism industry.

Similarly, this study does not consider the diffusion of new technologies and innovation

in tourism (among tourism managers, operators, etc.), as well as the innovation

absorptive capability; not all innovations are effectively implemented, meaning that the

effect of some of the innovations being analysed might be trivial. To this end, future

research should focus on the analysis of the innovation diffusion and actual

implementation.

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Figure 1: Tourism audio-visual patents distribution between 1996 and 2016
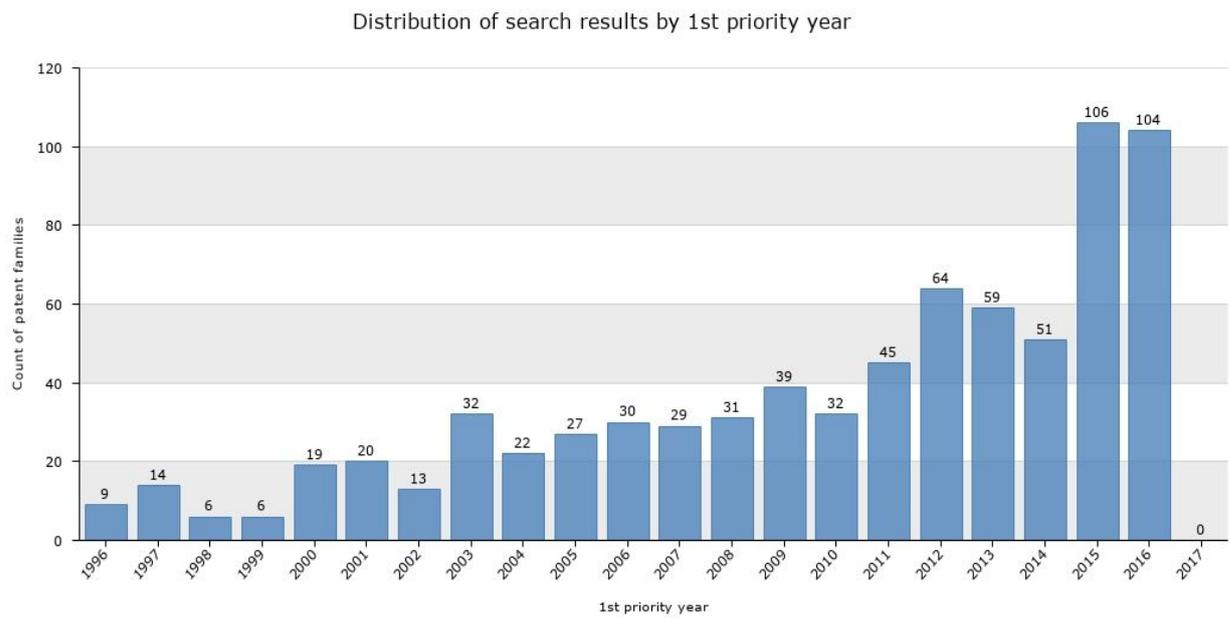
Distribution of search results by 1st priority year

Table 1. Comparison between % of growth of tourism patents and total patents

	2010	2011	2012	2013	2014
% growth total patents	1	1,07	1,13	1,15	1,11
% growth tourism audio-visual patents	1	1,40	2,00	1,84	1,59

Table 2. Comparison between % of growth of tourism patents and other sectors patents

	2010	2011	2012	2013	2014
Tourism audio-visual patents	1	1,40	2,00	1,84	1,59
Telecommunications	1	0,96	1,04	0,91	0,75
Medical technology	1	1,14	1,19	1,26	1,27
Pharmaceuticals	1	0,97	1,12	1,14	1,23
Food chemistry	1	1,17	1,28	1,33	1,48
Micro-structural and nano-technology	1	2,11	2,35	2,46	2,81
Transport	1	0,99	0,99	1,04	0,92

Figure 2: Frequency analysis of the most frequent terms appearing in the patent

Table 3: Topics extraction results

NO	NAME	KEYWORDS	EIGENVALUE	% VAR	FREQ	CASES	% CASES
9.	INCLUDING; VISITOR	INCLUDING; VISITOR; CONNECTION; SIGHT; MODEL; UTILITY; DISCLOSES; EQUIPPED; SETS; WARE; TOURISM; ATTRACTION; ELECTRIC; SETTING; CN	2.85	1.82	2115.	594.	0.7816
8.	SIMPLE STRUCTURE; ADVANTAGES	SIMPLE; STRUCTURE; ADVANTAGES; COST; NOVEL; LOW; CONVENIENT; MODEL; UTILITY; ARRANGED; CN	2.98	1.25	1896.	561.	0.7382
10.	GPS POSITIONING; POSITION INFORMATION	POSITIONING; GPS; POSITION; INFORMATION; NAVIGATION; MODULE; GUIDE; SCENIC; INTELLIGENT; VOICE; MAP; TOUR; ROUTE; BASED; SPOT	2.73	2.34	1777.	565.	0.7434
20.	TECHNICAL FIELD; EQUIPMENT	FIELD; TECHNICAL; EQUIPMENT; RELATES; UTILITY; MODEL; CN	2.18	1.1	1555.	567.	0.7461
3.	COMMUNICATION NETWORK; INTERNET	NETWORK; INTERNET; SERVER; COMMUNICATION; SYSTEM; TERMINAL; BASED; COMPUTER; WIRELESS; INVENTION; TECHNOLOGY; LOCATION	5.07	1.57	1175.	459.	0.6039
2.	UPPER; LOWER	UPPER; LOWER; PLATE; END; TOP; SIDE; GROOVE; ROD; FIXING; LEFT; BOTTOM; PORTION; FIXED; CONNECTED; BLOCK	8.06	1.99	1063.	429.	0.5645
4.	IMAGE; DIGITAL CAMERA	IMAGE; CAMERA; SOLVED; DIGITAL; DATA; STORED; IMAGES; PHOTOGRAPHING; DEVICE; RECORDING; VIDEO	4.02	1.36	956.	474.	0.6237
7.	USB INTERFACE; POWER SUPPLY	USB; SUPPLY; POWER; AMPLIFIER; PROCESSING; UNIT; AUDIO; CENTRAL; DECODING; INTERFACE; AUTOMATIC; EARPHONE; OPERATION; RECEIVING	3.08	1.75	918.	404.	0.5316
1.	MICROPROCESSOR; COMMENTARY	MICROPROCESSOR; COMMENTARY; FREQUENCY; RADIO; MP; OUTPUT; CHARACTERIZED; IDENTIFICATION; INPUT; SIGNAL; DECODING; BROADCAST; ADVANTAGES; RECEIVING; CHANNEL	24.22	1.94	810.	381.	0.5013
15.	SIGNAL RECEIVER; TRANSMITTER	RECEIVER; TRANSMITTER; SIGNAL; WIRELESS; MACHINE; GUIDE	2.38	1.1	546.	320.	0.4211

Table 4: Phrases extraction

	FREQUENCY	NO. CASES	TF • IDF
Utility Model	524	318	198,3
Scenic Spot	358	114	295
Tour Guide	238	72	243,6
Utility Model Discloses	228	185	139,9
Display Screen	218	93	198,9
Tourist Guide	124	39	159,9
Guide System	108	43	134,7
Tourist Attraction	107	60	118
Scenic Spots	103	56	116,7
Radio Frequency	102	48	122,4
Power Supply	84	58	93,9
Utility Model Relates	80	80	78,2
Sight Spot	75	35	100,3
Real Time	74	44	91,6
Invention Discloses	72	72	73,7
Guide Flag	70	19	112,1
Invention Relates	67	66	71,1
Processing Unit	63	29	89,4
Mobile Phone	62	25	91,9

Figure 3: MDS in the bigger cluster