

## Unfolding the Intellectuality of Smart Tourism

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### ABSTRACT

The creative uses of smart tourism have increased marketing effectiveness in the last ten years. The concept of smart tourism is still developing in the literature, and this study aimed to outline its evolution and current intellectual structure. The objective of this article is to examine the changes in smart tourism research by using keyword co-occurrence frequency, keyword centrality, and clustering. Furthermore, this study investigated the duration along with the evolution of the intellectual structure similarities by examining the correlation index of keyword centrality between different time segments. This is the first study in tourism literature that uses five centralities (i.e., degree, betweenness, closeness, eigenvector, and page rank) and network analysis to demonstrate changes in the intellectual structure of smart tourism. 724 documents published in Web of Science and Scopus were divided into 7-time segments. The keyword "Smart services" was found with the highest frequency and centrality. The continuous changes in keyword usage in different time segments revealed that the keyword "smart tourism" emerged during the 2017-2018 and 2021-2022 segments only. The research findings of this article may be helpful for academicians and practitioners of smart tourism.

**Keywords:** *Smart Tourism, Intellectual Structure, Evolution, Paradigm Shift, Centrality, Network Analysis.*

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### 1. INTRODUCTION

Tourism has always been associated with a desire to escape from daily routine activities and to rejuvenate post-work (Egger et al., 2020). With the support of its management systems, tourists can find key information about weather, location, and events and can plan their ideal vacation (Hamid et al., 2021). Since 2000, this management system has existed in virtual world, where it influences how people view and anticipate travel experiences (Ryan, 2017). From the industry's perspective, it guides travellers to destinations and propagates reviews freely, which are more influential than traditional marketing tools (Ryan, 2017). Tourism is one of those industries that has been proactive in embracing technological advancements (Buhalis & Law, 2008a). It has been significantly impacted by information and communication technology (ICT) because of the revolution created by the internet (Xu et al., 2017) and the transference of information technology across generations (Werthner & Klein, 1999). It is acknowledged that the tourism industry is one of the most prominent that has progressed rapidly due to e-tourism and started to offer smart tourism (Hamid et al., 2021). The term "e-tourism system" has grown quickly during previous years, which indicates the increased reliance on ICT-related businesses and services (Gretzel, Sigala, et al., 2015; Hamid et al., 2021). All travel sector activities have been digitized under the e-tourism system. It has also been initiated to improve the effectiveness of communication, information exchange, and the processing of transactions (Hamid et al., 2021). Like ICT, smart tourism has transformed the industry towards smart systems based on big data analysis (Buhalis & Amaranggana, 2013, 2015; Gretzel, Sigala, et al., 2015). Further, to date, its definition is constantly being developed (Hunter et al., 2015).

The universally accepted definition of smart tourism is yet to be defined in the literature because, to date, it has been used with different meanings according to the system involved in the process (Pai et al., 2020). Smart tourism is referred to as "tourism supported by integrated efforts at a destination to collect and aggregate/harness data derived from physical infrastructure, social connections, government and organizational sources, and human bodies/minds in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear focus on efficiency, sustainability, and experience enrichment" (Gretzel, Sigala, et al., 2015). According to Neuhofer

et al. (2015), it describes a specific technological application that enhances visitor experiences and adds positively to customer expectations. These days, a significant number of academicians and practitioners have been fascinated by it (Buhalis & Amaranggana, 2013; Gretzel, Sigala, et al., 2015) due to its ability to provide significant and adequate information as well as the quality of interconnection among tourism stakeholders (Boes et al., 2016; Gretzel, Werthner, et al., 2015). As a result, the academic community is concentrating on smart tourism as a research topic (Johnson & Samakovlis, 2019), and scholarly contributions that can help comprehend this trend are being developed as a result of collaborations among researchers of different disciplines (Celdrán-Bernabeu et al., 2018). Bibliometric studies have commonly employed the use of bibliographical and bibliometric data visualization to detect collaborative analyses like co-citation, co-word, co-authorship, and co-occurrence (Racherla & Hu, 2010). By utilizing social network analysis, a deeper understanding of intellectual advancement can be achieved through networks of collaboration (Benckendorff & Zehrer, 2013), particularly in the field of tourism (Ali Koseoglu et al., 2016). Researchers from several fields are investigating intellectual frameworks that are built upon keywords or citation data. Its frameworks have been examined in other disciplines like informatics (Ding et al., 1999; Park & Jeong, 2013) and economics and management (Pilkington & Meredith, 2009). The investigations used author co-citation analysis, author bibliographic coupling assessment (Park & Jeong, 2013), and co-words analysis (X. Chen et al., 2016). Co-word analysis is a method that effectively uncover the connections among themes by examining the connections between keywords (Ronda-Pupo & Guerras-Martin, 2012). However, more efforts are required in this field (Gretzel, 2018; Hunter et al., 2015). The existing literature indicates that review researches and papers mainly focus on bibliographic studies (Bavik, 2020; Chang et al., 2020; Gui et al., 2020). However, analytical and structural aspects, like citation and co-citation analysis, have drawn less attention. Several studies have focused on developing the intellectual structure in the tourism and hospitality discipline. These researches primarily studied tourism strategic administration (Koseoglu et al., 2019), management of revenue in tourism (Denizci Guillet et al., 2019), tourism investigations (Ali Koseoglu et al., 2016; Benckendorff & Zehrer, 2013; Pestana et al., 2019), technological self-service (Shin & Perdue, 2019), social media (Leung et al., 2017), and big data management in tourism (X. Li & Law, 2020). Several researchers have also examined the intellectual structure in different areas like medical tourism (de la Hoz-Correa et al., 2018), evaluation of journals (Martorell Cunill et al., 2019; Mulet-Forteza et al., 2019; Michael Hall, 2011), and our study presents the intellectual structure of smart tourism through pathfinder keyword network analysis. So far as author's knowledge is concerned, only a very few research is in existing literature have analysed the durability of the intellectual structure (Cho, 2020).

This study is aimed at identifying the intellectual structure and evolution of smart tourism through observation of the correlation index of keyword centrality between time gaps. By using keyword frequency and centrality, this article identified the gradual changes in the intellectual structure from 2009 to 2022, which was divided into seven-time segments each of two years. Monitoring of modifications in the intellectual structure can be detected through a change in the keywords' centrality (Cho, 2020). In contrast to all prior studies, this research has used distinctive and new analytical techniques and tools. It attempts to investigate intellectual structure by utilizing a methodology, already used in library and information science by Chen et al. (2019) and Cho (2020), who have noted shifts in intellectual structure by monitoring the correlation index of keyword centrality across time intervals in open access (OA) research. This paper contributes significantly to the research on smart tourism because it is the first study that highlights changes in intellectual structure with the help of five different centralities. Additionally, the application of centrality, clustering, and correlation demonstrated more robust results.

## 2. PRIOR RESEARCH REVIEW

### 2.1 Overview of Smart Tourism

Tourism has systematically retained its interdisciplinary nature since its inception in the early nineteenth century (Correia, 2021), and its research started to get attention in the twenty-first century (Correia, 2021). Several articles in the literature have addressed the significance of technological advancements for the growth of business practices and visitor satisfaction (Authors, 2014; Buhalis & Law, 2008b). The trend of the last decade indicates that tourists are now more focused on their whole travel experience, which is also a significant area of consideration for service providers (T. H. Lee, 2017; Lu et al., 2015). Rickly (2022) framed the developments from the review that have happened within the larger patterns of 42 years in tourism authentic studies (1979-2020). A. Liu et al. (2022) carried out a structured evaluation of the literature on the economic impact of tourism and techniques that have been used for obtaining precise estimations of impacts (i.e., the connection between tourism and economic benefit or development). ICT (Information and Communication Technology) is used in a system created through the smart concept. It optimizes the functioning of all organizations, leading to enhanced synergy. Smart tourism is a significant advancement in the use of ICTs in the tourism industry. It involves an integration of the material and administrative aspects of tourism within the world of digital media (Gretzel, Sigala, et al., 2015).

Contemporary tourism trends indicate that with increased average vacation time, competition among travel destinations is also rising (Ghorbani et al., 2020). One of the fundamentals of competitiveness is the use of technology and artificial intelligence (Ghorbani et al., 2020). The idea of describing "intelligence" in existing technologies has given shape to the

term "smartness" in recent times (Baggio et al., 2020). Smartness is more about the integration, synchronization, and organized utilization of various technologies (Gretzel, Sigala, et al., 2015). However, the conceptual framework of smartness has changed significantly, and smart development objectives have expanded tremendously (Gretzel, 2018). From an industry standpoint, it is vital to emphasize how smartness growth is advancing, primarily for destinations (Buhalis & Amaranggana, 2015). To bring smartness to destinations, all stakeholders have to be interconnected proactively by using technology for swift information exchange about tourist activities (Buhalis & Amaranggana, 2013).

The term "smart" combines digital and traditional tools that promote economic and social development (Pai et al., 2020). Smart includes knowledge, power, and interconnectivity for effective functioning (Gretzel, Werthner, et al., 2015), and it is also used in multiple contexts in operations (Hunter, 2021). Generally, smart words are associated with the ability to analyse and solve issues by using real-time information (Hunter, 2021). In tourism, smart means being quick, accessible, and economical for the traveller on the one hand and profitable, useful, efficient, and inventive for the industry on the other hand (Hunter, 2021). This is described as an organized and comprehensive management reform and refers to the integration of ICT with tourism for the digital advancement of the industry (P. Lee et al., 2020), as well as touristic activities that are aided by technology (Gretzel, Sigala, et al., 2015). It is also advantageous for travellers, corporations, and destinations (B. H. Ye et al., 2020), due to its propensity to guide the way for more sustainable growth and its popularity trends at the global level (Vargas-Sánchez & Saltos, 2019). "Smart" has obtained popularity in both the academic and practical worlds (Gajdošík, 2018) and is considered a resource management tool of innovative nature (Gretzel, Werthner, et al., 2015). In the last decade, the term "smart" has also extended to the tourism sector (Y. Li et al., 2017; Mehraliyev et al., 2019).

In the tourism literature, very few reviews of smart tourism researches, i.e., with various objectives, are available. Both qualitative and quantitative methods have been used to review the research on smart tourism (Mehraliyev et al., 2020). Mota et al. (2024) investigated the primary intellectual and topical growth along with categorizing and recognizing the core study substance with references and buzzwords related to open innovation. By employing co-citation analysis, Wider et al. (2023) recognized significant earlier research publications and currently popular topics in digital tourism. It directed the creation of digital tourism platforms and approaches with results that are environmentally friendly and socially responsible by incorporating AI and big data to offer customized travel suggestions (Wider et al., 2023). El Archi et al. (2023) analyzed the overlap between sustainability and digitalization in tourism locations through bibliometric analysis as well as aid in the creation of plans and regulations that will support the efficient and sustainable use of technological advances in tourism locations. El Archi et al. (2023) demonstrated the rising number of papers across the past few years as well as a growing fascination with the intersection of sustainability and digitalization in areas of tourism. Ercan (2023) analyzed papers on smart tourism destinations (STDs) that appeared in publications listed in the Web of Science (WoS) database employing bibliometric methods and concluded that the papers written about this topic lack a long history. The accepted fact is that research on STDs is in its early stages. The significant rise in the quantity of STD publications released during the past three years indicates that this subject has been a prominent trend in tourism research recently (Ercan, 2023).

Baggio et al. (2020) identified inadequacies and logical errors in the critical analysis of key literary works on the growth and management of smart tourism. Hamid et al., (2021) addressed cutting-edge research in the field of tourism recommendation systems (TRS). Dorčić et al. (2019) studied a detailed and systematic analysis of the academic literature on applications and mobile technology in smart tourism published between 2012 and June 2017. Mehraliyev et al. (2020) identified knowledge domains and thematic research trends in smart tourism and concluded that new research dimensions related to political and economic impacts, demand forecasting, and authenticity may be on the future agenda of research. Mehraliyev et al. (2019) investigated the life cycle, disciplinary approaches, collaboration trends, foundation, and social structure of smart tourism research. Borges-Tiago et al. (2022) assessed the intellectual structure of smart tourism and monitored its evolution. This study also indicated the limitations related to the small data set and the inclusion of articles only from journals published in English. Ye et al. (2020) investigated the smart tourism research trends, theories, regions, and themes and again noticed the limitations related to the use of a smaller number of documents for analysis. Hunter (2021) performed an integrative review of smart tourism and recommended enriching the results with more and more databases. But the study included only full-length, SCI-listed papers, which did not include some dimensions like authorship, co-authorship, big data, and virtual reality. Johnson & Samakovlis (2019) examined the research on smart tourism through the visualization of collaborative networks and suggested adding more documents to the input data from multiple databases for greater clarity of results. The number of academic documents that were incorporated in the data-gathering phase of the study was constrained because only journal articles, i.e., from 2008 to 2018 were included. It also examined keyword co-occurrence and co-authorship and calculated keyword centralities, i.e., betweenness, closeness, and eigenvector. Our study used the keyword frequency with five centralities, i.e., degree, betweenness, closeness, eigenvector, and page rank for more clearly and robust results. Further, this study used correlation to illustrate the changes in the intellectual structure of smart tourism research.

## 2.2 Social Network Analysis

In the analysis of organizational frameworks, social network analysis is a key tool to recognize important nodes (individuals or groups) inside the network, which has a grouping of individuals or objects that are linked with one another (Das et al., 2018). It is a vital index and indicates which node occupies a significant position in a network (Zhang & Luo, 2017). Social network analysis is a widely used analysis in bibliographic studies (Morehouse & Saffer, 2018; Zhang & Luo, 2017). This analysis reveals the connections between authors, documents and keywords and also produces a network of specialists (Morehouse & Saffer, 2018). Rousseau (2002) stated that social network analysis is a valuable technique for understanding and visually representing social structures. This incorporates the societal framework of a global community of scholars. The analysis offers crucial insights into literature, journals, and, notably, authors, which academics consider to be of utmost significance (Pasadeos et al., 1999). To identify significant nodes in a network, centrality measurements, being quantitative, are widely accepted tools in the literature. A variety of centrality measurements have been created and used in social network analysis (Das et al., 2018).

Social network analysis was used by numerous studies in tourism field like Benckendorff & Zehrer (2013); Casanueva et al. (2013); S. H. Lee et al. (2013); Leung et al. (2012) and Q. Ye et al. (2013) but in case of smart tourism only Mehraliyev et al. (2019) and Johnson & Samakovlis (2019) studies have used it by calculating only three centralities i.e. betweenness, closeness, and eigenvector. These three centralities measure establishes the actor that manages information within other nodes (Das et al., 2018), used to determine the sum of the distances between each node (Patil & Brazdil, 2007) and the significance of its neighbours (Patil & Brazdil, 2007) respectively, but page rank centrality which is advance version of eigenvector (Allesina & Pascual, 2009; X. Liu et al., 2005; Patil & Brazdil, 2007) measure node's network importance and recommends only for multivariate network analysis, was not used for analysis. Further, degree centrality which measure the entire quantity of direct links among nodes (Bolland, 1988; Shaw, 1954), was also not used. Our study not only used betweenness, closeness, and eigenvector but also used more centrality i.e. degree and page rank.

## 2.3 Pathfinder keyword network analysis

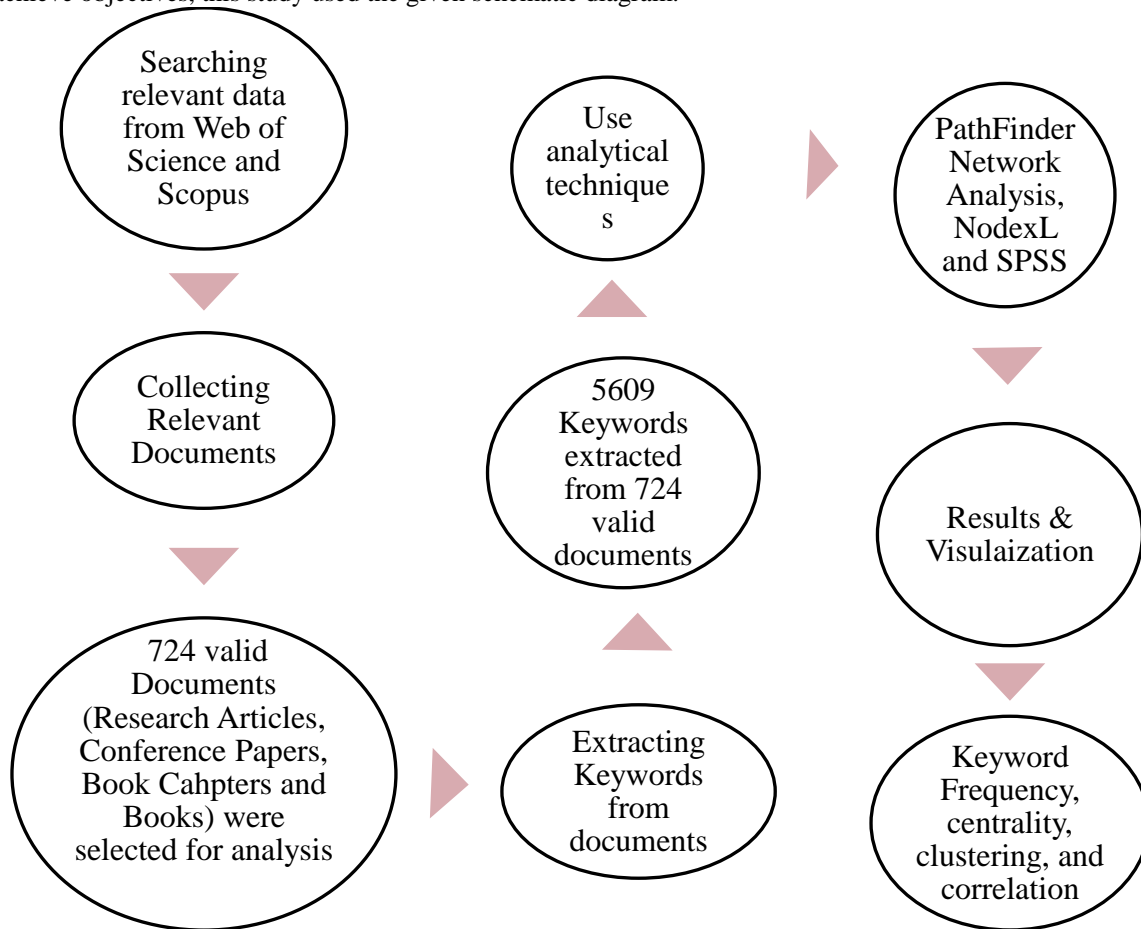
In tourism, network analysis focuses on the various relationships, exchanges that exist, and collaborations that exist among participants (Johnson & Samakovlis, 2019). The goal of this network analysis is to acquire a summary of research themes that may guide future studies by examining prior research to identify which authors and which themes are contributing to the generation of knowledge in the discipline (Racherla et al., 2008). Bibliometric methods of analysis, for example, co-authorship and co-citation, may be employed to identify concealing intellectual connections and research trends (Ali Koseoglu et al., 2016; Benckendorff & Zehrer, 2016; Racherla et al., 2008). These methods can also help identify the growth of global scholarly networks (Ali Koseoglu et al., 2016; Benckendorff & Zehrer, 2013). Yang et al. (2016) investigated the social networks and connections among Chinese researchers in the field of smart tourism research. The investigation employs a bibliometric analysis and social network analysis. Similar to this, Suh and Jeong (2013) used co-word analysis to examine the intellectual framework of open access. They identified 18 topic categories connected to institutional repositories, open-access journals, and academic publishing after using keywords extracted from open-access research published in international journals between 1998 and 2012 to assess the intellectual structure.

Keyword network analysis was carried out by Cho (2014) upon institutional repositories, that serve as the foundation of open access. It involves creating a network by extracting keywords from the literature and determining the similarity among keywords based on their frequency, and how often they occur together (Cho, 2020). In an earlier publication, Chen et al. (2019) conducted a study that examined shifts in the intellectual framework by analysing a correlation index of keywords across many sections, with a temporal interval. The similarities and disparities of the networks were clarified by examining the correlation coefficients that relate to the centrality indexes of keywords generated at each phase. In addition to Chen et al. (2019) work, Cho, (2018) also examined the intellectual structure's resemblance through an analysis of the keyword centrality index connection. The pathfinder network analysis, which evaluates co-occurrence's significance, is utilized primarily for intellectual structure analysis. When complete weighted links are constructed in a state, a path that breaks a triangle inequality is removed, creating a network known as the pathfinder network. When the triangle inequality breaks down, it means that there is a path that is indirectly linked across multiple short connections instead of a longer path that has a direct connection (Lee, 2006a).

The foundation of most social relationships is a binary structure. Nevertheless, within the realm of bibliometrics, the application of weighted network analysis possesses significant advantages and is considered more valuable. The importance of a weighted connection depending on the quantity of co-occurrence is evident in co-word or co-citation analysis (Lee, 2013). The degree, closeness, and betweenness centralities are frequently employed in the study of social networks. The weights of links between keywords are not considered in these centralities. Thus, citation analysis frequently uses metrics such as closest neighbourhood centrality, mean connection, mean feature association, and triangle betweenness centrality (which measures the extent to which a node connects other nodes) (J.-Y. Lee, 2006). In contrast to other review studies of the smart tourism field, this study is similar to research investigations (Miguel et al., 2016; Zhao & Wu, 2014) in the discipline of open access research field that identified the centrality of Keywords with keyword network analysis.

### 3. RESEARCH METHODOLOGY

To achieve objectives, this study used the given schematic diagram.



**Figure 1: Schematic representation of research methodology.**

The first step was aimed to search the relevant documents published in English till 2022 on Web of Science and Scopus databases with ten keywords frequently used in literature "smart tourism", "smart tourist", "smart attractions", "smart tourist attractions", "smart destination", "smart tourism destination", "smart tourism technology", "smart services", "smart travel" and "smart traveler". While searching, only the article title row was used which resulted total 1133 documents, out of which 927 were from Scopus and 206 from Web of Science. The second step was to filter the searched documents by considering the document type, language and year of publication. Johnson & Samakovlis (2019); Mehraliyev et al. (2019); Borges-Tiago et al. (2022); and Ye et al. (2020), concluded that a smaller number of documents used in the analysis limited the generalization of the results, so unlike these all-previous researches, this study used all research articles, books, book chapters, and conference papers for analysis. The first article on smart tourism published in literature was found in the year 1991 and only 26 articles (3.6%) were published up to 2008 against a total of 724 articles. So, the study includes only those articles published from 2009 to 2022 to get more balanced distribution of articles among different time periods and after applying all filters in the form of year, document type, and language. 724 documents were finalized for analysis. To make the results clearer, the publication period of 14 years (i.e., from 2009 to 2022) was divided into seven-time segments, each of which was of a two-year duration. The third step was to extract the indexed keywords from the selected documents. Software created a total of 5609 keywords from the selected documents, the distribution of which is presented in Table 1.

Time Segments (T)	No. of Documents	No. of Keywords
2009-2010 (T1)	20	180
2011-2012 (T2)	28	369
2013-2014 (T3)	31	305
2015-2016 (T4)	74	680
2017-2018 (T5)	141	1099

2019-2020 (T6)	215	1481
2021-2022 (T7)	225	1495
<b>Total</b>	724	5609

**Table 1: List of time segments, number of documents and keywords.**

In the last step, the changes in intellectual structure were studied with the help of keywords and centrality measurements. The paradigm shift of intellectual structure was examined by using correlation techniques on data created for different time segments. The pathfinder network analysis (which includes SEMI, COOC, and WNET software) developed by Lee (<https://cafe.daum.net/wnets>) was used for calculations and as shown in table 1.

Analytical Techniques	Software Used
Keyword frequency	SEMI
Keyword co-occurrence	COOC
Keyword centrality and clustering	WNET
Cluster Visualization	Nodexl
Correlation Analysis	IBM SPSS

**Table 2: List of software used for data analysis and data visualization.**

The inception of the Pathfinder Network may be traced back to the field of cognitive psychology, along its recognition became widespread through the works of White (2003) and Chen (2004). The technique was disseminated during the development of open-source software capable of analysing bibliographic data (Lee, 2006a). It has since been employed in numerous bibliometric research. According to Lee (2006a), PFNet is believed to be more beneficial in conveying both the general and the detailed framework, like multiple-dimensional scaling or clustering analysis, which is a conventional methodology for examining the intellectual structure throughout the academic sector. Cite Space (6.1.R6 (64-bit) Basic) was used to visualize the evolution of smart tourism by taking keyword co-occurrence as an analysis unit. For visualization of documents (dataset generated by software with same keywords), different criteria (i.e., time slicing, node types, selection criteria, and pruning) were used for analysis. The top 20 levels and 5% of the most cited or occurred items from each time slice were selected in the software. The visualization is in the timeline view format with years, keywords, and clusters.

## 4. RESULTS

### 4.1 Intellectual Structure Analysis

The intellectual structure of smart tourism is described through seven-time segments, each of 02 years duration. In the intellectual structure of the first segment i.e., 2009-2010, 20 documents were analyzed, and found that the "smart services" keyword was with the highest frequency (16). For centrality measurement and analysis, 12 keywords with a frequency  $\geq 3$  were selected. The "Information technology" keyword was found with nearby significance (Degree centrality, 3), information manager (Betweenness centrality, 36), information broker (closeness centrality, 0.043), and important (eigenvector centrality, 0.165) in comparison to other nodes of the network. The keyword "Smart services" was found with the highest value of degree centrality (3) and closeness centrality (0.043) while it was in second rank in Betweenness centrality (34) and eigenvector centrality (0.148).

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Smart Services	16	3	34.000	0.043	0.148	1.505
Business Process	3	1	0.000	0.030	0.071	0.576
Information technology	6	3	36.000	0.043	0.165	1.496
Service Model	3	2	10.000	0.032	0.084	1.098
Internet	5	1	0.000	0.022	0.031	0.628
Telecommunication networks	3	2	10.000	0.029	0.065	1.125
Information services	3	1	0.000	0.027	0.052	0.591
User interfaces	3	3	26.000	0.037	0.127	1.557
Context- awareness	3	1	0.000	0.026	0.053	0.603
Middleware	3	3	19.000	0.034	0.111	1.599
Ubiquitous technology	3	1	0.000	0.026	0.053	0.603
Ubiquitous computing	3	1	0.000	0.024	0.040	0.617

**Table 3: Main keyword centrality and cluster of T1 (2009-2010)**

Four clusters were formed in this segment. User Interfaces (C1) cluster includes telecommunication networks, information services, and the internet. Information technology (C2) was the second cluster with keywords service model and ubiquitous technology. Middleware (C3) cluster has context awareness and ubiquitous technology as keywords. The fourth cluster i.e. Smart Services (C4) was found with a single keyword i.e. business process.

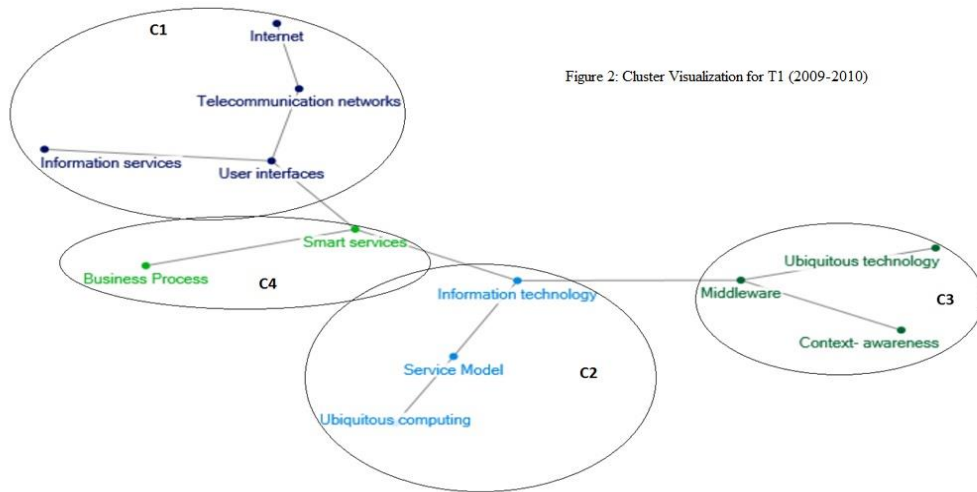


Figure 2: Cluster Visualization for T1 (2009-2010)

Figure 2: Cluster Visualization for T1 (2009-2010)

The second segment (2011-2012) contained a total of 28 documents and the keyword "smart services" had the highest frequency (13) with the selection of the top 11 keywords appearing  $\geq 3$ . In contrast to the rest of the network nodes, the keyword "smart services" exhibited nearby significance (Degree centrality, 3), information controller (Betweenness centrality, 29), and information agent (closeness centrality, 0.045). Another keyword was "context-aware" with higher nearby significance (Degree centrality, 3) and major node (Eigenvector centrality, 0.187) in this period. "Middleware" was found with highest page rank centrality (1.623).

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Smart services	13	3	29.000	0.045	0.155	1.524
Information technology	3	2	21.000	0.040	0.112	1.043
Information retrieval	4	2	16.000	0.033	0.063	1.084
Internet	3	2	9.000	0.027	0.041	1.156
Cloud computing	4	1	0.000	0.022	0.017	0.641
Quality of service	3	1	0.000	0.032	0.080	0.582
Context-Aware	3	3	27.000	0.043	0.187	1.540
Mobile applications	3	1	0.000	0.031	0.077	0.586
Middleware	3	3	17.000	0.036	0.133	1.623
Intelligent systems	3	1	0.000	0.027	0.068	0.610
Ubiquitous computing	3	1	0.000	0.027	0.068	0.610

Table 4: Main keyword centrality and cluster of T2 (2011-2012)

Three clusters were designed in this segment which is Context-aware (C1) with keywords such as middleware, mobile applications, ubiquitous computing, and information systems. Cloud computing (C2) and Smart Services (C3) were other clusters of this segment.

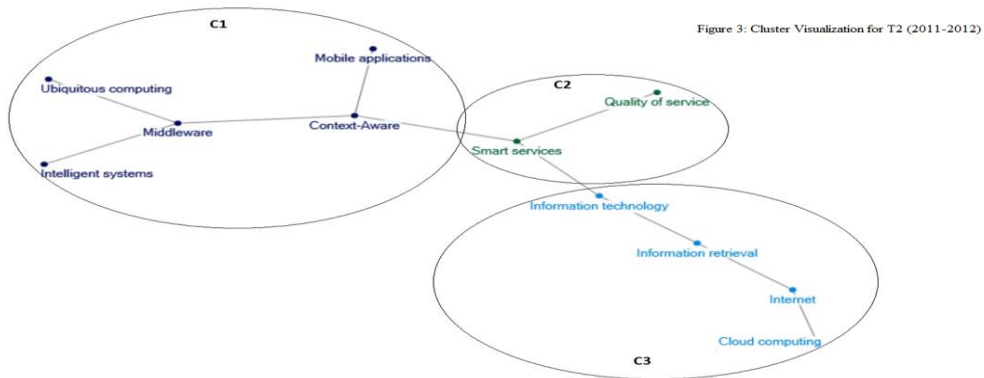


Figure 3: Cluster Visualization for T2 (2011-2012)

In the third segment (2013-2014), 31 documents were analyzed, and 12 keywords appeared  $\geq 3$  which resulted in the keyword "internet" being observed with the highest frequency (06). The keywords "internet" demonstrated proximity significance (Degree centrality, 3), information supervisor (Betweenness centrality, 34), and information operator (Closeness centrality, 0.032). Internet of Things (IOT) was another influential node (Eigenvector centrality, 0.144) during this period.

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Internet	6	3	34.000	0.032	0.144	1.520
Internet of Things (IOT)	3	2	24.000	0.029	0.155	1.045
Smart services	5	2	30.000	0.032	0.136	1.018
Interoperability	4	1	0.000	0.020	0.067	0.614
Internet of thing (IOT)	3	3	19.000	0.024	0.110	1.638
Semantics	3	1	0.000	0.020	0.067	0.614
Information management	3	1	0.000	0.024	0.088	0.581
Web services	3	2	18.000	0.023	0.039	1.089
Geographic information systems	3	2	10.000	0.020	0.031	1.159
Multi agent systems	3	1	0.000	0.016	0.012	0.643
Smartphones	3	2	28.000	0.030	0.079	1.029
Information technology	3	2	24.000	0.027	0.072	1.050

Table 5: Keyword frequency and centrality of T3 (2013-2014)

Focusing on the clusters formed during this period were the Internet of Things (IOT) (C1), Geographical Information Systems (C2), Smart Services (C3), and Information Management (C4).

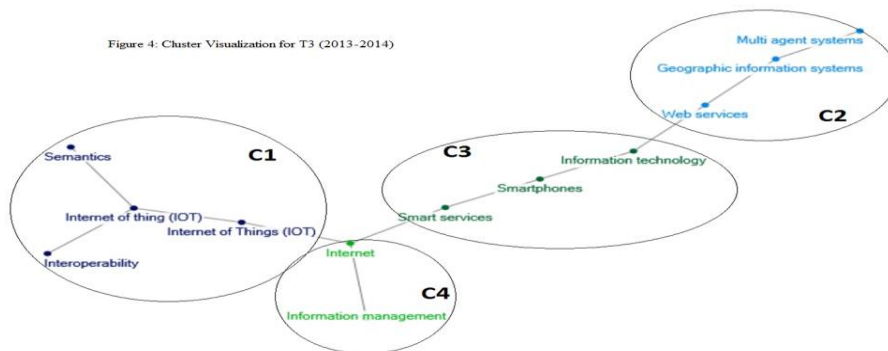


Figure 4: Cluster Visualization for T3 (2013-2014)

The intellectual structure was noticed with the help of 74 documents during the fourth segment (2015 to 2016) and picked top seven keywords appeared  $\geq 4$  times. The keyword "smart services" was with the highest frequency (18) and three clusters Big Data (C1), Smart Services (C2), and Internet of Things (C3) formed. The keyword "smart services" only showed close prominence (Degree centrality, 3), information administrator (Betweenness centrality, 11), information activator (Closeness centrality, 0.100), and most notable node (Eigenvector centrality, 0.220).

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Smart services	18	3	11.000	0.100	0.220	1.640
Internet of things	10	2	5.000	0.077	0.179	1.162
Internet	6	1	0.000	0.056	0.076	0.644
Human computer interaction	5	2	5.000	0.071	0.117	1.176
Big data	4	2	8.000	0.091	0.204	1.114
Innovation	4	1	0.000	0.067	0.133	0.615
Social networking (online)	4	1	0.000	0.053	0.071	0.650

Table 6: Main keyword centrality and cluster of T4 (2015-2016)

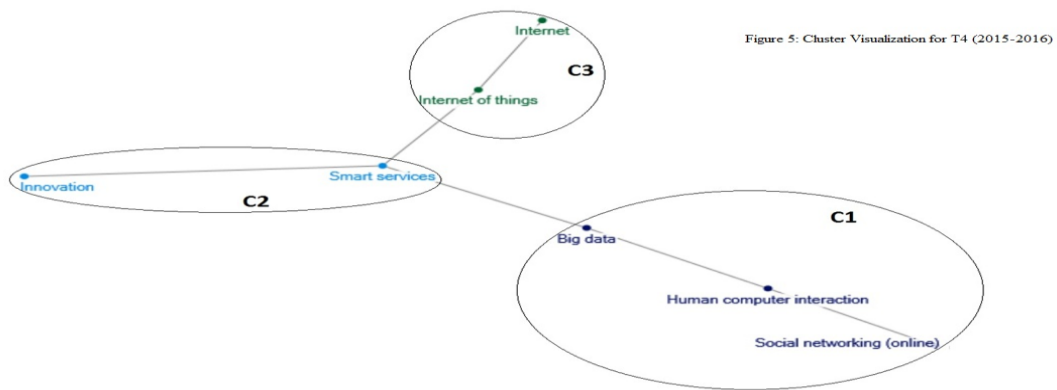


Figure 5: Cluster Visualization for T4 (2015-2016)

The number of documents increased in the fifth segment (2017-2018) as 141 documents were collected and got centrality with the top 10 keywords appearing  $\geq 8$ . "Smart services" was a keyword with the highest frequency (29) in this segment. The cluster formation in this segment contains three clusters Smart Tourism (C1), Big Data (C2), and Smart City (C3). The keyword "smart city" was the nearest significance (Degree centrality, 3), information director (Betweenness centrality, 24), information driver (Closeness centrality, 0.048), and most prominent node (Eigenvector centrality, 0.180).

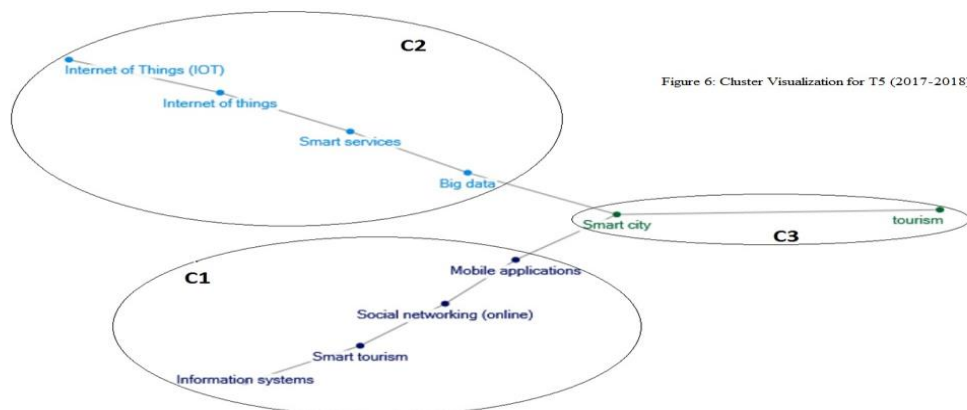


Figure 6: Cluster Visualization for T5 (2017-2018)

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Smart services	29	2	14.000	0.037	0.101	1.088
Big data	15	2	18.000	0.043	0.154	1.049
Internet of things	20	2	8.000	0.030	0.073	1.158
Internet of Things (IOT)	12	1	0.000	0.024	0.032	0.642
Smart tourism	17	2	8.000	0.030	0.073	1.158
Information systems	11	1	0.000	0.024	0.032	0.642
Smart city	13	3	24.000	0.048	0.180	1.539
Mobile applications	8	2	18.000	0.043	0.154	1.049
Social networking (online)	8	2	14.000	0.037	0.101	1.088
tourism	8	1	0.000	0.034	0.099	0.586

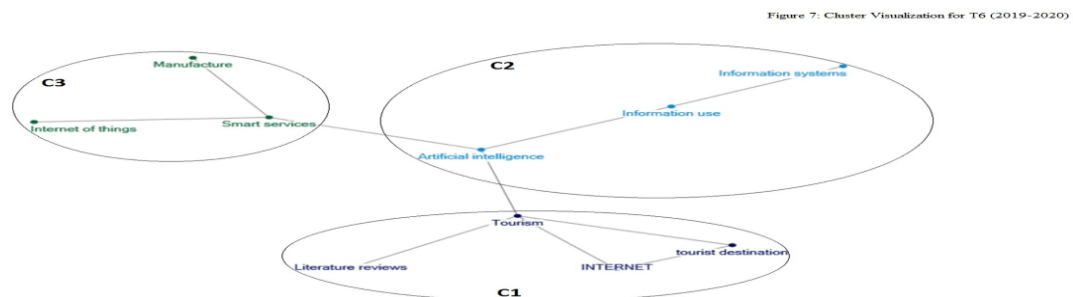
**Table 7: Main keyword centrality and cluster of T5 (2017-2018)**

In the sixth segment (2019-2020), 215 related documents were collected and the top 10 keywords appeared  $\geq 11$  times. The keyword with the highest frequency (47) was "smart services" again in this unit. The "Tourism" keyword was the nearest relevance (Degree centrality, 4) and most valuable node (Eigenvector centrality, 0.211) in this period. Another keyword "Artificial intelligence" was information admin (Betweenness centrality, 26) and information regulator (Closeness centrality, 0.067).

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Smart services	47	3	15.000	0.053	0.091	1.560
Manufacture	11	1	0.000	0.037	0.037	0.592
Tourism	32	4	20.000	0.059	0.211	1.787
Literature reviews	11	1	0.000	0.040	0.085	0.530
Internet of things	22	1	0.000	0.037	0.037	0.592
tourist destination	21	2	0.000	0.042	0.143	0.921
INTERNET	12	2	0.000	0.042	0.143	0.921
Artificial intelligence	20	3	26.000	0.067	0.151	1.425
Information use	16	2	8.000	0.048	0.073	1.067
Information systems	14	1	0.000	0.034	0.029	0.603

**Table 8: Main keyword centrality and cluster of T6 (2019-2020)**

Three clusters formed in this segment also Tourism (C1), Artificial Intelligence (C2), and Smart Services (C3).



**Figure 7: Cluster Visualization for T6 (2019-2020)**

During the seventh segment (2021-2022), 225 related documents were listed and chosen top 10 keywords appeared  $\geq 13$  times. Main keyword centrality and cluster of U7 (2021-2022). The "Tourism" keyword was the most adjacent prominence (Degree centrality, 4), information head (Betweenness centrality, 25), information generator (Closeness centrality, 0.050), and most relevant node (Eigenvector centrality, 0.190) in this period.

Keywords	Keyword Frequency	Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality	PageRank
Tourism	59	4	25.000	0.050	0.190	2.074
Smart tourism	29	2	8.000	0.038	0.151	1.124
Smart services	32	2	18.000	0.045	0.082	1.056
Internet of things	20	2	20.000	0.050	0.170	1.039
Tourism industry	13	1	0.000	0.029	0.051	0.628
Big data	22	1	0.000	0.036	0.119	0.591
tourist destination	15	2	8.000	0.031	0.030	1.161
tourism development	13	1	0.000	0.025	0.019	0.644
Smart city	15	1	0.000	0.036	0.119	0.591
FOUNDATIONS	15	2	14.000	0.038	0.070	1.092

**Table 9: Main keyword centrality and cluster of T7 (2021-2022)**

The keyword "Tourism" got the highest frequency (59) and four clusters were formed such as FOUNDATIONS (C1), Tourism (C2), Internet of things (C3), and Smart Tourism (C4) during this period.

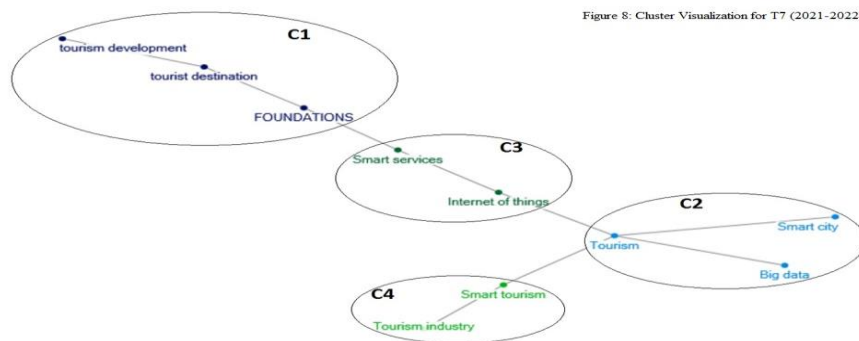


Figure 8: Cluster Visualization for T7 (2021-2022)

**Figure 8: Cluster Visualization for T7 (2021-2022)**

#### 4.2 Changes in Clusters

The changes in subject clusters with time are visible in Table No. 10. Their names are given based on keyword frequencies and centralities. In the first segment T1, smart services were the main keyword in the research area. Apart from this, user interfaces, information technology, and middleware were also included. It can be observed a huge change in the next segment (T2) as new clusters were formed such as context-aware and cloud computing. Smart services had a dominance again in this segment. In T3 and T4, smart services had consistency with new clusters like the Internet of Things (IOT), web services, big data, information management, and the internet of things. It can be seen a huge change again in the cluster forming. The cluster of big data had a consistency in the next segment (T5) also. The clusters of smart tourism and smart city again emerged in this segment. In the last two segments (T6 and T7), the clusters of artificial intelligence, tourism, smart tourism, internet of things, and foundations were formed. Tourism formed clusters in both these segments. Artificial intelligence and foundations appeared during these periods. Smart tourism and internet of things appeared again in the last segment. Smart tourism again also gained momentum in the research area from the last segment.

**Table 10: List of Clusters**

Keyword	T1	T2	T3	T4	T5	T6	T7
User Interfaces	C1						
Information technology	C2						
Middleware	C3						
Smart Services	C4	C3	C3	C2		C3	
Context-Aware		C1					
Cloud computing		C2					
Internet of Things (IOT)			C1				
Web services			C2				
Information management			C4				
Big data				C1	C2		
Internet of things				C3			C3
Smart tourism					C1		C4
Smart city					C3		
Tourism						C1	C2
Artificial intelligence						C2	
FOUNDATIONS							C1

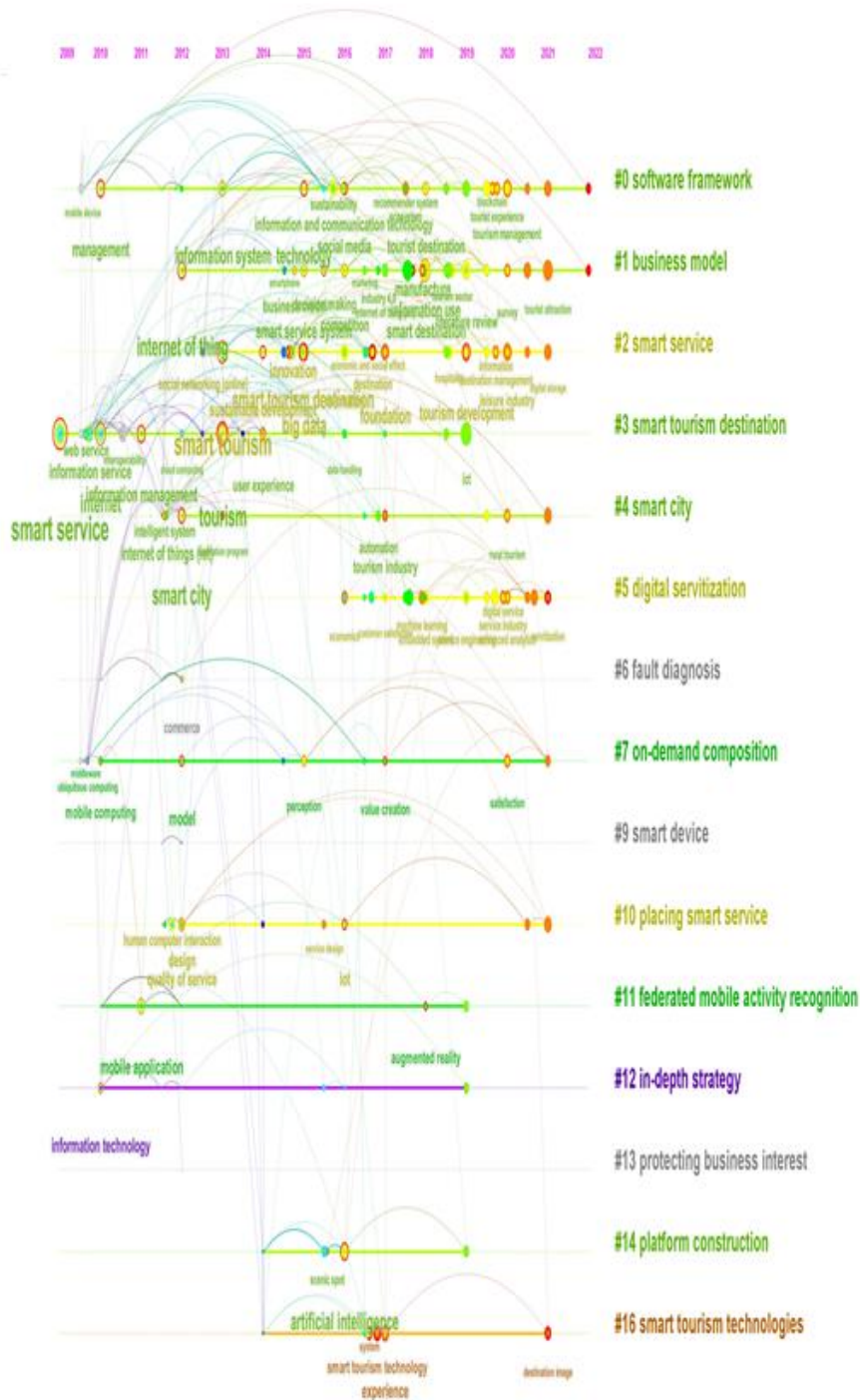
#### 4.3 Correlation between time segments of centralities

Table no. 11 shows the correlation between each period to understand the changing influence of keywords. 46 keywords were analyzed for correlation analysis. This analysis was performed by pairing each time segment and results obtained are shown in table no. The highest correlation, between the two segments 2017-2018 and 2021-2022 i.e. ( $r=0.476$ ), indicates that smartness and technology, both keywords were found highly associated. The second highest correlation value ( $r=0.386$ ) was between the 2015-2016 and 2017-2018-time segment which indicates that keywords like smart services, big data, and internet of things were also related in the period 2015-2016. The correlational value of 2009-2010 was found insignificant with time segments 2017-2018, 2019-2020 and 2021-2022. The low value of  $r$  in the correlation of 2011-2012 and 2013-2014 with 2017-2018, 2019-2020, and 2021-2022 indicated almost nil significance. This was because of a major change in keywords after 2015-2016. It can be interpreted that intellectual structure underwent a significant change after 2016 as there was an expansion in smart tourism with ever-new themes. It was also the start of the development stage of smart tourism as various countries adopted the strategies and concept of smartness in their tourism businesses.

**Table 11: Correlation among time segments**

Time Segments	U1	U2	U3	U4	U5	U6	U7
U1 (2009.1-2010.12)	1.000	0.312*	0.041	0.047	-0.138	-0.132	-0.129
U2 (2011.1-2012.12)	0.312*	1.000	0.062	0.071	-0.021	-0.116	-0.114
U3 (2013.1-2014.12)	0.041	0.062	1.000	0.082	-0.035	-0.135	-0.131
U4 (2015.1-2016.12)	0.047	0.071	0.082	1.000	0.386**	0.136	0.320*
U5 (2017.1-2018.12)	-0.138	-0.021	-0.035	0.386**	1.000	0.143	0.476**
U6 (2019.1-2020.12)	-0.132	-0.116	-0.135	0.136	0.143	1.000	0.333*
U7 (2021.1-2022.8)	-0.129	-0.114	-0.131	0.320*	0.476**	0.333*	1.000

4.4 Evolution



**Figure 9: Timeline View of Evolution Visualization of Smart Tourism Research**

Keyword co-occurrence of 856 documents was assessed with Cite Space (6.1.R6 (64-bit) Basic). Node, labels, and clusters were visualized for investigation of smart tourism evolution between 2009 and 2022. 15 clusters were extracted by applying all criteria which already discussed in the research methodology. Figure no. 9 shows keywords that were mostly used in each period. The cluster "Software Framework" has the longest existence from 2009 to 2022. The keywords in the early years of this cluster were smartphone, management, context, sensor network, information system, sustainability, and recommender system. The keywords related to travel and tourism like tourist destination, smart tourism city, tourism

destination, smart tourist, tourist experience, and tourism management emerged after 2018. The "Business model" cluster has with second longest existence with business, industrial, and technological concepts. Keywords that existed only from 2012 to 2022 were the internet of thing, business model, decision making, competition, marketing, life cycle, survey, and smart application. However, the terms tourist attraction and tourism service were visible only in the last phase of the cluster in the years 2021 and 2022.

A variety of terms were used in the middle part of the structure with some major clusters like smart service, smart tourism destination, smart city, on-demand composition, placing smart service, federated mobile activity recognition, and in-depth strategy. Some clusters like digital servitization, platform construction, and smart tourism technologies, had a short duration of three to six years only. The cluster "digital servitization" did not have a long duration despite having a lot of keywords like other big clusters of networks. It had no particular keyword related to smart tourism. The clusters like fault diagnosis, smart devices, and protecting business interest were found with very small duration i.e., only in the year of 2012.

## 5. IMPLICATIONS

### 5.1 Theoretical and practical implications

Scholars and professionals in the tourism sector consider significant importance related to research on smart tourism. By studying smart tourism, academics can gain a deeper understanding of the state of the field, spot research gaps and trends, assess the influence of research, and develop methods. This can assist academics in expanding their understanding of smart tourism and assist industry professionals in staying current with emerging trends, making wise judgments, and enhancing the tourist experience. This study has some theoretical implications. The study first identifies research gaps in the field of smart tourism, pointing out areas that need further investigation and theoretical development regarding the evolution of this term. These gaps include a more thorough analysis of keywords used in smart tourism research in the last few years and a more thorough investigation of intellectual development. It may contribute to generating new ideas and concepts in smart tourism research. Second, by using keyword co-occurrence analysis, the study may help create a new theoretical framework for understanding emerging trends and preferences, which could bring fresh dynamics to the tourism industry.

## 6. DISCUSSION

Smart tourism research gained momentum in the last decade and literature has examined various dimensions of smart tourism. But to date, research in the field did not get due attention from researchers. There are many review studies in the field of tourism but very few are in the case of smart tourism and confined only to destination, services, cities, and hospitality. Available literature shows that the review studies examined knowledge development, thematic research trends, bibliometric analysis, intellectual structure, and evolution. Research methodology and databases were mostly common in all these studies. Borges-Tiago et al. (2022) only identified and monitored the intellectual structure and evolution of smart tourism with some limitations. But our study has a different approach from all these review studies to do the intellectual structure and evolution of smart tourism.

### 6.1 Intellectual Structure

This study reveals the intellectual structure through the keyword frequency, centralities, and clusters. Major centralities of each keyword have been calculated for every time segment. A correlation analysis was conducted to highlight the changes among the various time segments through keyword centrality. Numerous keywords appeared with different frequencies and centrality which were used in the article's titles and cited references in the smart tourism field from 2009 to 2022. The keyword "smart services" was used widely in the smart tourism field, especially from 2009 to 2016. It was significantly associated with the article's title and references as smart service was used to deliver personalized service to enhance the service experience of customers smartly (Kabadayi et al., 2019). This phase includes all articles that proposed new smart services as an entire group, including infrastructures, service systems, or associated needed support (Dreyer et al., 2019). Apart from smart services, the "internet" was another keyword with a high value of significance in research on smart tourism during 2013-2014. New communication platforms are enabled by advancements in technology across the Internet to empower both service providers and users (Litvin et al., 2008). Keywords "big data" and "smart city" were significantly focused on enhancing the value of other components in the field of smart tourism in 2017-2018. Tourism stakeholders showed great interest in the concept of smart city when it gained popularity in the last decade of the 21st Century (Göktaş Kulualp & Sari, 2020). Keywords related to technology were used in the tourism sector in the further period such as "tourism" and "artificial intelligence" Keywords had a great impact on the research of smart tourism as they started to increase the engagement of stakeholders with interactive applications (Stroumpoulis et al., 2022). The keyword "smart tourism" was used during 2017-2018 and 2021-2022 only in the article's title and cites references to consider as an innovative development tool for the tourism sector. So, it does not get attention in most of the segments except two segments 2017-2018 and 2021-2022. The interpretation derived is that smart tourism as a keyword emerged in 2017-18. In 2019-20 it did not get much attention again but in 2021-22 it was the core of attraction for researchers. These particular changes are being represented with the correlation analysis among all segments. The correlation was strongly significant

between the 2017-2018- and 2021-2022-time segments while it was weak between time segments 2009-2010 and 2017-2018. Most of the words used in the previous period disappeared in the next segments.

### **6.2 Evolution on the basis of keyword co-occurrence**

The evolution was investigated through keyword co-occurrence by using the software Cite Space (6.1.R6 (64-bit) Basic). Several keywords were derived to evaluate the progress of smart tourism research. A shift of research focus was witnessed by using different keywords. The visualization indicated the duration of clusters and co-occurrence of the keywords during different years. Clusters like "software framework", "on-demand composition", "smart tourism destination" and "business model" not only had the longest duration but also had a maximum number of different keywords. The trending and innovative keywords used in these clusters were included consistently. Apart from these, some clusters had a duration of 10 years but had more keywords such as "smart service", "smart city", "placing smart service" "federated mobile activity recognition" and "in-depth strategy". These clusters included keywords that show the integration of smartness and the tourism industry. Cluster "digital servitization" had less duration despite having more keywords as it did not include more keywords related to tourism and its terms while cluster "smart tourism technologies" had a long duration despite having fewer keywords as it had genuinely some innovative, technical, and trending keywords related to tourism. Many keywords were found to co-occur during the initial, middle, and later stages of evolution. But the keyword "smart tourism" occurred only in a few years i.e., from 2013 to 2015 and 2020-21 which indicates the development of the field is in progress. In all 15 clusters, keywords related to tourism were found with lower values in the initial stage. But tourism was used mostly in the middle and later stages of evolution and the same was true for "smart tourism" terms.

## **7. CONCLUSION**

While several studies examine the intellectual structure, only a limited number of research investigations have detected shifts in the intellectual structure. This study holds theoretical significance as it examines the duration of similarities within intellectual structures by examining correlations among intellectual structures throughout time. This methodology is valuable in practice as it may be applied to analyse the intellectual structure in future studies across other domains (Cho, 2020).

This study investigated the evolution and intellectual structure in smart tourism by using keyword frequency, centrality, and clusters for the period of 2009 to 2022. Pathfinder network analysis was employed to identify the changes in the intellectual structure and evolution of smart tourism and these changes are explained with the help of correlation analysis. The findings of this study reveal the higher frequencies of smart services, big data, information technology, the internet of things, and tourism in all segments. Centralities like degree, betweenness, closeness, eigenvector, and page rank were calculated in each period. The keywords that appeared with the highest centralities were tourism, artificial intelligence, smart city, internet, smart services, and information technology. More clusters were found in 2009-2010, 2013-2014, and 2021-2022-time segments in comparison to other segments. While studying intellectual structure, major changes were explored in the field with keyword analysis for each segment. The gradual changes of keywords in time segments indicate that the keyword "smart tourism" emerged during 2017-2018 and 2021-2022.

15 clusters were formed in the evolution structure of smart tourism research. "Software Framework", "on-demand composition", "smart tourism destination" and "Business model" were the major clusters found with long duration. Tourist destination, smart tourism city, tourism destination, smart tourist, tourist experience, tourism management, internet of thing, business model, decision making, competition, marketing, life cycle, survey, and smart application were the keywords used in these clusters. This paper tries to add to the literature on smart tourism and proposes a novel approach to the investigation of intellectual structure development i.e., with the exploration of keyword frequency, centrality and clusters as (Johnson & Samakovlis, 2019) tried to build a shape in the production of smart tourism knowledge with a collaborative network of researchers and (Mehraliyev et al., 2019) revealed the social structure and dominant methods of smart tourism research. It supports the evolution of smart tourism research significantly through keyword co-occurrence as Borges-Tiago et al. (2022) advocated about the evolution of smart tourism research. Further, it is concluded that the keyword smart tourism did not appear significantly in the field of tourism in the last decade but its use was visible during 2017-18 and 2021-22.

## **8. LIMITATION AND FUTURE RECOMMENDATION**

This study has some drawbacks like it included only two databases i.e., Web of Science and Scopus. The use of more databases can enrich the input for better understanding and generalization. This study used only research articles, books, book chapters, and conference proceedings while review, editorial, erratum, letter, note, early access, and news items can also be included for analysis in the future. The other limitation is that, the evolution was done only with the help of keyword co-occurrence can also be improved. This study used Pathfinder network analysis software and advocated that future study can use more advanced technical software for more clarity.

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