Multi-criteria Decision-making in the Tourism Domain:
The Past, Present and Future of the Research Field

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The key objective of this paper is to provide a comprehensive overview of the application of Multi-Criteria Decision-Making (MCDM) methods in papers published in prominent journals within the WoS database related to tourism. Based on the 252 papers which met the search criteria, this study determined the most commonly used MCDM methods as well as the reasons for their application. The study also identified the authors who employed the methods in their papers and whether or not the papers are team-oriented. The time frame within which the papers were published, along with the publishing trends within the specific period and finally, a model intended for predicting the developing trends within this research area was developed. Finally, the application of social network analysis gave an insight into the intellectual structure of the subject discipline and pointed to the most influential papers that were the subject of the content analysis.

Keywords: ANN, Bibliometric analysis, Content analysis, DEA, Prediction, Social network analysis

Introduction

Tourism is a very popular domain both from a practical and theoretical or scientific standpoint. The practical aspect of tourism refers to its popularity within a wider economic and social life scope – tourism as a branch of the economy and social activity. The academic community has frequently recognised the significance of tourism, which is reflected in the number of scientific or professional papers in the most relevant journals globally. In 2020, the Web of Science (WoS) academic database encompassed some 26 journals in the realm of tourism, hospitality and leisure. Papers published in these journals are thought to present cutting-edge studies in contemporary tourism science.

Systematic quantitative literature reviews (bibliometric analyses) are highly advantageous and can be highly important in all scientific areas. It was only recently that two groups of scientists[1,2] – systematised their research review studies in the field of tourism. By analysing nine world-leading journals in the domain of tourism and hospitality, the former group found that within bibliometrical studies (n = 190), review studies had the greatest share (157 papers, 82.6%), followed by evaluative studies

and relational studies (24 and 9 papers respectively, 17.4% combined). Chronologically, the first paper encompassed by the analysis was published in 1988 and the number of published papers steadily rose over time. The majority of papers were published in the Tourism Management Journal (45, 23.7%). Kim *et al.*[1] found some 171 review papers in the domain of tourism, the major journals being the International Journal of Contemporary Hospitality Management (13.5%), the International Journal of Hospitality Management (12.3%) and Tourism Management (11.7%). The first paper was published in 1982, however the five-year intervals studied showed a rising trend in the number of papers published. Topics covered in the review papers are as follow: economics and finance (29 papers, 17%), customer behaviour (24 papers, 14%), marketing (22 papers, 13%), tourism and hospitality research in specific regions (18 papers, 11%), methodologies and statistics techniques in tourism and hospitality research (12 papers, 7%), specific sectors of tourism and main research trends and themes in tourism hospitality literature (12 papers, 7%), environmental strategies and management in tourism and hospitality (ten papers, 6%), human resource practices and issues in the tourism and hospitality (nine papers, 5%), information technology management in tourism and hospitality (nine papers, 5%), business operations and

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management in tourism and hospitality (six papers, 4%), strategic management of business in hospitality and tourism (five papers, 3%), development of theories and models in tourism and hospitality research (three papers, 2%).

The list above details the vast variety of topics and factors influencing the success of tourism as a whole. It also suggests that tourism, as well as the majority of other fields, necessitate a multidisciplinary approach for solving problems, whereas decision-making requires observing a great number of often opposing criteria. Decision-making based on a number of criteria (MCDM) has been deployed in science since the mid-20th century. A plethora of books, both on theory and practice, have been published in this domain of science to date. According to Chauhan & Vaish[3] and Zavadskas et al.[4], these include Multi-Attribute Decision-Making (MADM) and Multi-Objective Decision-Making (MODM) approaches. An increasing number of scientific publications in this scientific field have prompted many authors to engage in their systematisation.

Zavadskas et al.[4] performed the most comprehensive survey of review papers on the use of MCDM in different areas. They discovered 71 MCDM review papers in 36 different research fields. Some of the essential ones are energy fuels (18 papers), operations research management science (17 papers), management (12 papers) and environmental sciences and ecology (ten papers). However, none of the review papers are concerned with the use of MCDM in the field of tourism, hospitality and leisure. Mardani et al.[5] reviewed a total of 393 articles on the use of MCDM in diverse areas, which were published from 2000 to 2014 in more than 120 peer-reviewed journals (extracted from Web of Science). They then classified them into 15 fields and established that only 11 original research articles (2.80%) were within the field of tourism management. Köksalan et al.[6] aimed to conduct a comprehensive survey of papers in which MCDM methods were used for solving problems in the field of tourism whereby the survey was to address the scientific areas over the entire historical period.

Objectives

The objectives of this research were:

(1) Identifying the trends followed so far in publishing such papers in different periods;
(2) Identifying the most popular journals and methods

used;
(3) The survey of authors that have had the most significant contribution to development within a specific scientific area and the affiliating institutions or countries;
(4) Classification of the MCDM methods based on their suitability for different areas of tourism;
(5) Determining the citation correlation among papers
(6) Singling out the papers of critical importance for the intellectual structure of the subject area and the content analysis;
(7) Prediction of the quantity of future scientific contributions in this multidisciplinary field.

Methodology

In order to meet specific and globally-oriented objectives of this study, a search was undertaken, focusing on key terms (search phrases) in titles, abstracts and keywords in all the tourism (hospitality/leisure/vacation) related journals with an impact factor within the WoS academic database. In the Clarivate Analytics Journal Citation Report for 2020, there were 26 journals matching these criteria, of which Tourism Management was the most influential one with an impact factor of 7.432. Advanced search options were used on the journals' publishers' websites: Sage Journals (6 journals); Elsevier/Science Direct (8 journals); Emerald Insight/Emerald Publishing (3 journals); Taylor & Fracis Online (8 journals); Wiley Online Library (1 journal).

The search was completed during December 2020, based on words and phrases referring to: *MCDM, MADM, MODM, multi-criteria analysis*, *multi-attribute analysis*, *multi-criteria assessment* and *multi-criteria evaluation*, as well as the abbreviations and full names of the most prominent traditional and relatively recently developed MCDM methods: *AHP (Analytic Hierarchy Process), ANP (Analytic Network Process), DEA (Data Envelopment Analysis), DEMATEL (DEcision MAking Trial and Evaluation Laboratory), ELECTRE (ELimination Et Choix Traduisant la REalité), MAUT (Multi Attribute Utility Theory), PROMETHEE (Preference Ranking Organization METHod for Enrichment of Evaluations), SAW (Simple Additive Weighting), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), VIKOR (VIšekriterijumska optimizacija i KOmpromisno Rešenje), WPM (Weighted Product Model) and WSM (Weighted Sum Model)*,

ARAS (Additive Ratio ASsessment), COPRAS (COmplex PRoportional ASsessment of alternatives), MOORA (Multi-Objective Optimization on the basis of Ratio Analysis), MULTIMOORA (Multi-Objective Optimization by Ratio Analysis plus Full Multiplicative Form), SWARA (Step-wise Weight Assessment Ratio Analysis) and WASPAS (Weighted Aggregated Sum Product ASsessment).

Subsequent to the search for papers and before the pre-processing of the data, all papers resulting from the search (n = 301) were filtered and the papers published before a specific journal was introduced into the WoS database were excluded from the sample. The sample was then reduced to 252 papers (including those that had not been published at the time of the search but had been accepted for publishing – with *published online* status).

After the full papers were read, it was determined whether a paper fulfilled the requirements to be included in the analysis. The following aspects were addressed in the analysis: Is the method in question truly implemented in the paper or is it only mentioned in the keywords, abstract or title? Does a certain abbreviation truly represent some of the methods or does it refer to another term? A similar, however less comprehensive methodological approach for a more specific research field was used by Garabinović *et al.*[7] In accordance with this, Fig. 1 briefly depicts the data collection methodology.

The data referring to the publications involved in the final selection were coded in a simple flat-file database in Excel. The traits pertaining to the values of each paper (record in the database) were as follows: (1) journal title; (2) paper title; (3) authors' names; (4) authors' affiliations (institutions and countries); (5) year of publishing; (6) key words; (7) MCDM method used. Based on the database

Fig. 1 — Data collection methodology

quantitative indicators, a bibliometric analysis, Social Network Analysis (SNA) and content analysis were made and an artificial neural network model for predicting the number of papers for the ensuing year in a particular journal involving a specific method was made.

Bibliometric Analysis

Bibliometrical analysis and content analysis were completed based on various studies.[8–11] As far the bibliometric analysis is concerned, both evaluative and relational techniques were applied. *Evaluative bibliometric analysis* implies the basic analysis of bibliographic material in terms of determination the number of journals, papers, authors, citations, dynamics of paper publishing, the most frequent authors, the most frequent keywords, affiliations, etc. On the other hand, more advanced and complex *relational bibliometric analysis* deals with relationships between different parameters such as authors, papers, affiliations, etc.[12] In order to visualise the intelectual structure of the subject area, relational bibliometric analysis is usually accompanied by Social Network Analysis (SNA).[13,14] The SNA of paper citations, widely used in the tourism domain[15–18] can "enable the measurement, evaluation, and visualization of relationships and relationship patterns" by "combining mathematics, graph theory and computer science".[19] The analysis was performed by using UCINET and NetDraw software and the following parameters were considered: density, the clustering coefficient, centralisation, degree centrality and betweenness centrality. *Density* is the level of citation linkage across the network. It has a value from 0 to 1, and can be interpreted as the "probability that a tie exists between any pair of randomly chosen nodes" Borgatti *et al.*[20] The *clustering coefficient* represents the level of citation linkage at cluster level. It also takes values in range from 0 to 1 and shows the level of cohesion – not across the whole network, but within specific network areas. *Centralisation* refers to reliance of citation network on single node. *Degree centrality* shows the number of citation links of individual papers and therefore provides an insight into the most frequently-cited papers, while *betweenness centrality* shows the number of times individual papers served as a closest citation connector between adjacent papers. According to Borgatti *et al.*[20], high value betweenness centrality network elements are important because they are "in a

position to filter information and to color or distort it as they pass it along". In addition, the analysis also established the core and periphery elements of the papers' citation network, whereby core elements have better connectivity with other nodes, greater impact on the network and its structure, and in short, represent the most distinguished papers in the subject field.

Content Analysis

Content analysis is a commonly used research methodology within social sciences and its use progressed with the increasing amount of articles and textual materials on the Internet. Initial efforts regarding content analysis methodology have been initiated at the beginning of the 1920s, however only recently have been increasingly deployed within the tourism research, according to Stepchenkova et al.[21], "less sophisticated than in other disciplines" (p. 454). Weber (1990, p. 9)[22] defined content analysis as "a research method that uses a set of procedures to make valid inferences from the text". This methodology aims to examine the existing textual data with the idea to identify key codes that researchers should pay attention to and further develop categories based on the wider meaning of the identified codes.

Predictions via Artificial Neural Networks

With the aim of predicting future publications in this field, artificial neural networks were used in the analysis. Besides the collection, selection and pre-processing of data, the methodology of application of the technique also encompasses data transformation and formation, evaluation and testing of the model. The stages above, conventionally applied in data mining, are presented in a number of stydies.[23–26]

Results and Discussion

Based on the defined methodology, the final selection included some 252 papers that were the subject of further analysis. The yearly dynamics of paper publishing are shown in Fig. 2. The papers were published between 1997 and 2020. Since 2006, there has been a steady increase in the number of papers, with a surge from 2009 to 2012. The greatest number of papers were published in 2019 (n = 27 – 10.7% of the total number of papers) and three of those papers published online that year were published in journals in print form in 2021.

Over the last decade – which accounts for one third of the publishing period of papers – 213 papers were published, accounting for 84.5% of the total number.
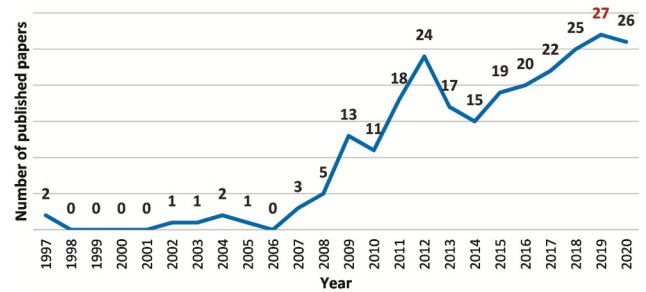

Fig. 2 — Yearly dynamics of paper publishing

In the past decade, 15.5% papers were published (n = 39), while only two papers were published (0.07%) between 1997 and 2000. The publishing of such papers has been on the rise recently, which is in line with the increase in the number of published papers in general and papers on the use of MCDM.[4–6]

The results will be presented in five separate sections – the first of which relates to journals and methods, the second to the authors, the third one is focused on keywords and key issues of MCDM application, the fourth one involves SNA and content analysis, while the final section refers to prediction of future trends in this area.

Prominent Journals and Methods

The table below shows the number of papers by journals, as well as methods used in the papers (Table 1) whereas there are a certain number of papers where two or more methods were employed.

Column ∑A shows the numbers of papers by journals in descending order. The papers have so far been published in 20 journals (out of 26 considered in the analysis, in accordance with the established methodology). The greatest number of papers were published in Tourism Management (n = 47 – 18.6%), followed by Tourism Economics (n = 41 – 16.2%).

The authors opted for nine MCDM methods (out of the 18 that were the subject of the search). The Tourism Management journal also has a variety of applied methods in the papers (n = 9 – column ∑B), which was anticipated given the number of papers published. This variety of methods is also typical of the Tourism Management Perspectives journal, where five different methods were applied in only eight papers.

The DEA method, the most commonly used method in papers in the field of tourism, was employed in no fewer than 122 papers. It is followed by the AHP, ANP and DEMATEL methods, with 55, 26 and 23 papers respectively. The DEA and AHP

Table 1 — Papers by methods and journals

	DEA	AHP	ANP	DEMATEL	TOPSIS	VIKOR	ELECTRE	PROMETHEE	WSM	∑A	∑B
Tourism Management	20	8	5	4	6	3	2	1	1	**47**	**9**
Tourism Economics	27	8	1	1	2	0	1	0	0	**41**	**6**
International Journal of Hospitality Management	13	4	6	6	0	0	0	2	0	**28**	**5**
Asia Pacific Journal of Tourism Research	8	6	2	2	0	0	1	1	0	**21**	**6**
International Journal of Contemporary Hospitality Management	13	3	1	1	0	0	0	0	0	**17**	**4**
Current Issues in Tourism	5	3	4	5	2	4	0	0	0	**16**	**6**
International Journal of Tourism Research	6	3	0	0	0	0	0	0	0	**11**	**2**
Journal of Travel and Tourism Marketing	3	3	2	1	0	0	0	0	0	**10**	**4**
Journal of Sustainable Tourism	2	4	3	1	0	0	0	0	0	**10**	**4**
Tourism Management Perspectives	1	2	1	0	0	0	1	1	0	**8**	**5**
Journal of Hospitality and Tourism Research	6	2	0	0	0	0	0	0	0	**8**	**2**
Annals of Tourism Research	4	1	0	0	0	0	0	1	0	**7**	**3**
Journal of Hospitality, Leisure, Sports and Tourism Education	1	5	0	0	0	0	0	0	0	**6**	**2**
Journal of Travel Research	3	1	0	0	0	0	1	0	0	**5**	**3**
Journal of Hospitality and Tourism Management	2	0	0	1	1	0	0	0	0	**4**	**3**
Cornell Hospitality Quarterly	4	0	0	0	0	0	0	0	0	**4**	**1**
Tourism Review	2	0	0	0	1	0	0	0	0	**3**	**2**
Journal of Destination Marketing and Management	2	1	0	0	0	0	0	0	0	**3**	**2**
Journal of Hospitality and Tourism Technology	0	1	0	1	0	0	0	0	0	**2**	**2**
Journal of Tourism and Cultural Change	0	0	1	0	0	0	0	0	0	**1**	**1**
∑C	**18**	**16**	**10**	**10**	**5**	**2**	**5**	**5**	**1**		
∑D	**122**	**55**	**26**	**23**	**12**	**7**	**6**	**6**	**1**		

Notes: ∑A– *number of papers in journal;* ∑B– *number of MCDM methods discussed in papers in journal;*
∑C – *number of journals with papers about the MCDM method;* ∑D – *number of papers with MCDM methods*

methods also stand out as related to the number of journals with papers which addressed them (18 and 16, respectively – column ∑C in Table 1). Emrouznejad and Yang (2018)[27] state that the DEA is one of the MCDM methods which experiences exponential growth concerning "the number of publications related to its theory and applications".

It is important to emphasise that two methods were used in 16 papers, while three methods were used in six papers. In 20 papers, instead of applying any specific method, the authors developed their own methods based on multi-criteria decision-making approach.

A significant result of this analysis is that none of the relatively recently developed methods, such as ARAS, COPRAS, MOORA, MULTIMOORA, SWARA and WASPAS, was considered in the study of the papers, which suggests that authors in this domain tend to opt for well-established methods.

Prominent authors and research centres

Out of 703 authors, 531 authors contributed to the 252 papers analysed (no duplicates). The average number of authors by paper was 2.74 which involved 13 Spanish authors and the majority of papers had either two or three authors (32.14% and 31.35% respectively).

Only 91 author (17.14%) participated in the writing of two or more papers, whereas 12 authors published more than four papers (Fig. 3).

Albert George Assaf is the most prominent author in the sample with twelve papers published (4.76% of all papers), being the principal author of eleven of those papers. Professor Assaf is a renowned author in

this specific research field and his recognised authorship is confirmed by the number of citations (n = 2703) and his *h*-index of 32 (Scopus preview – Assaf, Albert Georges – Author details – Scopus, 2021).
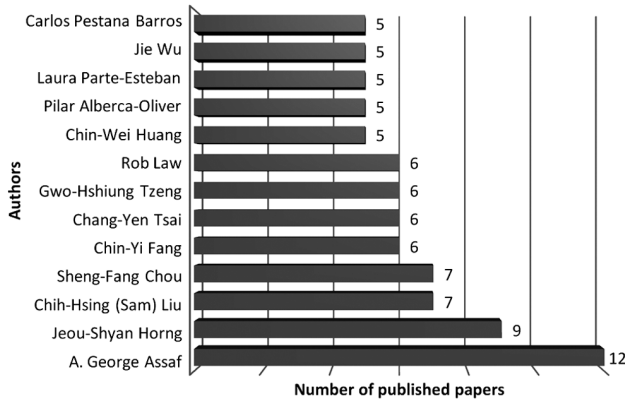
It was anticipated that the DEA method would be the most commonly used among authors in the study. Eight out of twelve authors use the DEA method exclusively (Albert George Assaf, Carlos Pestana Barros, Chin Yi Fang, Jie Wu, Chin-Wei Huang, Laura Parte-Esteban, Pilar Alberca-Oliver).

Fig. 4 demonstrates the collaboration among authors (co-authorship) and applies only to authors who had more than one paper published. The arrows linking authors bear the number of papers they wrote jointly. The authors are classified into 21 groups, which is considered a cooperation network. The most extensive cooperation networks are those involving Albert George Assaf and Jeou-Shyan Horng.

Fig. 3 — Most frequent authors (> 4 published papers)
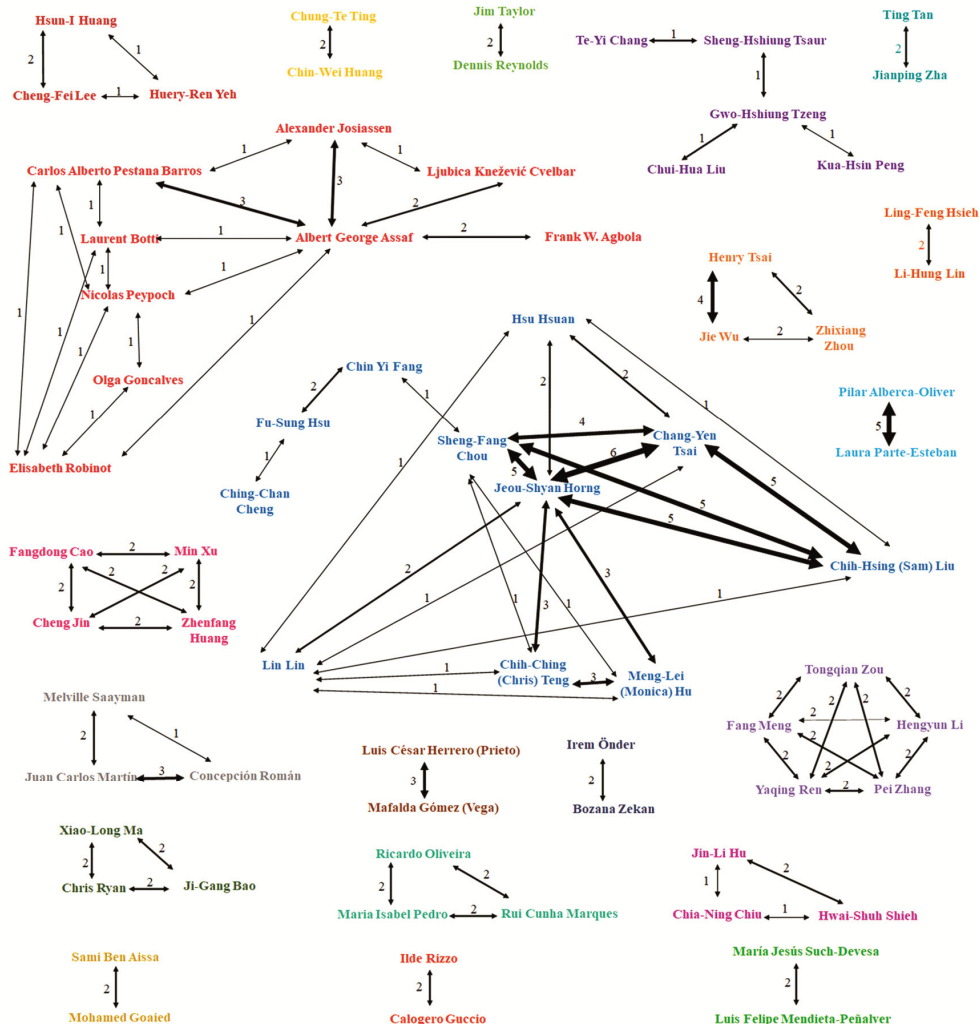

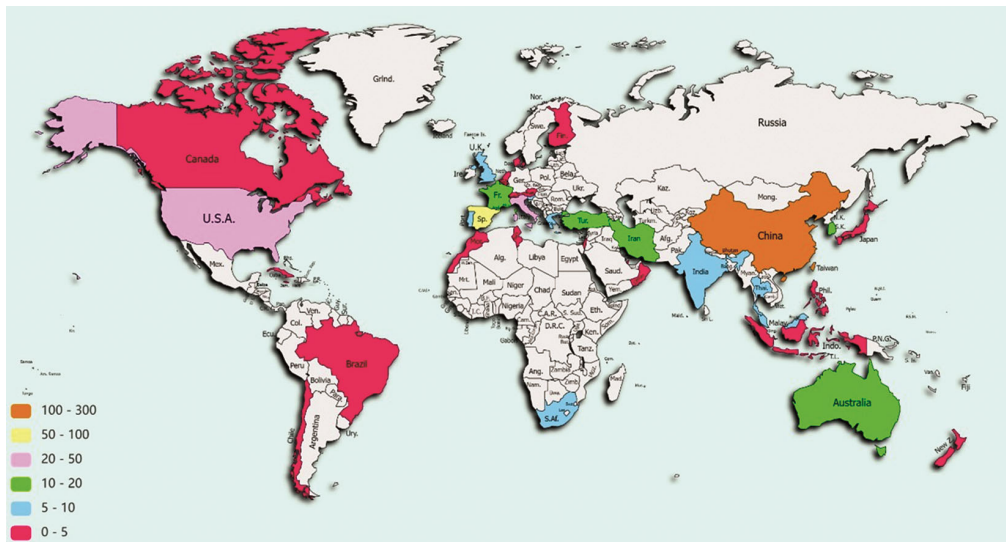Fig. 4 — Author collaboration (co-authorship)
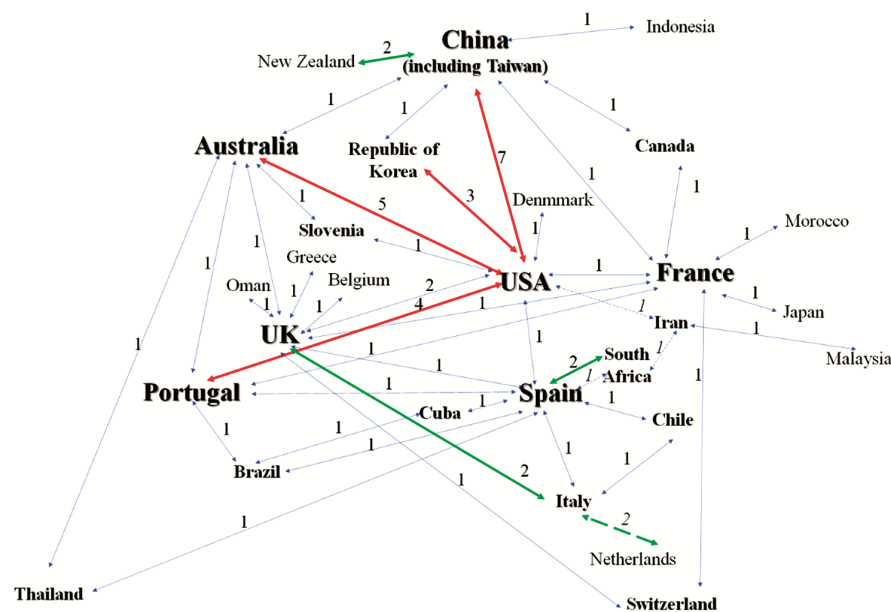
Fig. 5 — Authors by countries

Fig. 6 — Collaboration among countries

Authors from 37 countries participated in writing the papers analysed in this research and are numerically shown in Fig. 5. Authors declaring affiliations with more than one country are considered as authors from both the countries stated. The majority of papers were written by Chinese authors (131 papers – 51.98%; 233 authors – 43.88%), then authors from Spain (32 papers – 12.7%; 69 authors, 12.99%), followed by authors from the USA (30 papers – 11.90%; 30 authors, 5.65%).

As for the correlation between the collaborating authors and the countries they come from, in 204 papers, the authors are based in the same country (80.95% of papers), whereas the authors of 41 papers (16.26%) and 7 papers (2.78%) are from two or three countries respectively. As shown in Fig. 6, the most frequent collaborating countries are therefore the USA (10 countries), the UK (9), Spain (9), France (8), China (7), Australia (6) and Portugal (5). Given the number of Chinese authors, based on the data available, it is concluded that Chinese authors are relatively less cooperative with authors from other countries.

Keyword Frequency Analysis

The following word cloud (Fig. 7) depicts the most frequent keywords in the papers analysed. The image was created using the Rapid Miner tool and all key

Fig. 7 — Keyword frequency analysis

words from all the papers analysed were used as inputs. In conclusion, the most frequent word used is DEA, whereas words indicating frequently used methods are DEMATEL and AHP.

As for the areas of application of the methods, based on the words shown in the Fig. 7 below, they are mostly applied to hotels and the hotel industry in general. Further analysis showed that in papers pertaining to hotels (70 papers), the word DEA was used in 47 papers, AHP in nine papers (in two papers the word was combined with the PROMETHEE and DEMATEL methods). The word ANP was used in five papers (in two papers it was combined with DEMATEL). Other methods were significantly less employed. These results are in agreement with Ashrafi et al.[28], who states that "existing literature related to evaluating the efficiency of the hotel industry, generally, uses different types of radial Data Envelopment Analysis (DEA) to compare the relative efficiency of different hotels in a location".

Assuming that some important areas of application of the MCDM methods may not be found among the 1,256 key words in the 252 papers analysed, the subsequent reading of the titles demonstrated that the MCDM methods were used for ranking/comparison or general decision-making in restaurants (ten papers), travel agencies (11 papers) and websites (six papers). The DEA was used in six out of ten papers related to restaurants and in four out of 11 papers concerned with travel agencies (AHP was used in five papers).

Interestingly enough, DEA was not used in papers related to websites.

Social Network Analysis

The implementation of the SNA of paper citations reduced the sample (252) by 32 papers, which due to the lack of citation links with other papers, are perceived as isolated elements with no particular importance for the intellectual structure of the research area. Thus, Fig. 8 shows the citation network of 220 papers. The average density of the citation network of papers is 0.016, which can be interpreted as satisfactory (solid), based on Casanueva et al.[15], in which the citation network density with a number of elements markedly lower than 0.1077 was read as quite high, and the statement in Borgatti et al.[20], that smaller networks more easily achieve higher densities. Also, according to Van der Zee & Bertocchi[29], "in practice a degree between 10−1 and 10−2 is believed to be high". The diagram shows that out of 48.180 potential links between the sampled papers, 771 citation links were identified. The anticipated higher value of the clustering coefficient (0.132) suggests a higher level of cohesion and citation linkage among individual clusters than at the level of the overall network, which in addition to low correlated parts, contains exclusively interconnected papers (Zou et al.[30] and Meng et al.[31]; Ma et al.[32] and Wang et al.[33]; Hajizadeh et al.[34] and Malik and Bhat[35]). Additionally, the centralisation of the whole network amounts to 0.1177, which implies that the
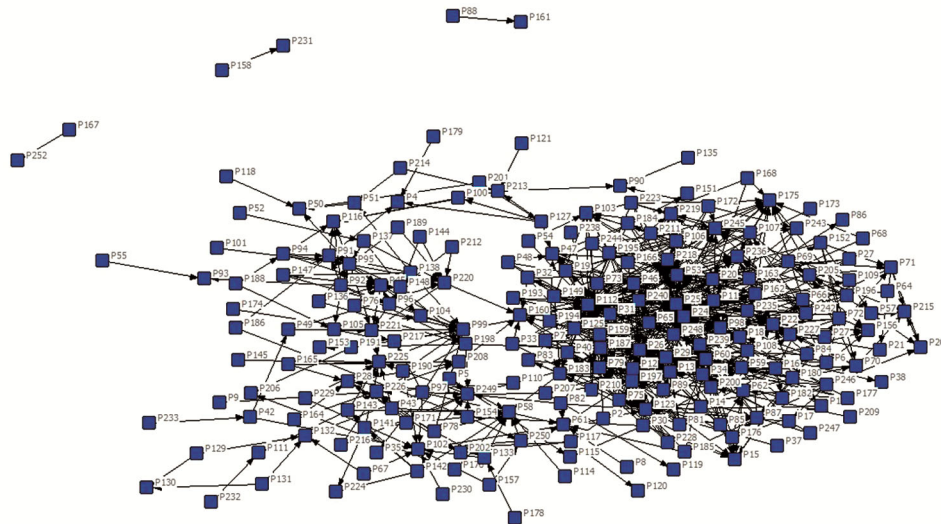
Fig. 8 — The paper citation network

paper citation network significantly relies on a single node.[20]

In order to determine the major and the most influential papers key to both the network structure and the research field, the centrality metrics of individual papers were established. The papers with the highest values of *degree* and *betweenness centrality* are presented in Table 2.

The greatest number of citation linkages were made by Hwang and Chang[36], while the best citation connector among different network elements was the paper of Benito *et al.*[37] Papers ranked within the first ten based on both parameters (degree centrality/betweenness centrality) are particularly important for the dissemination of knowledge. These papers are Benito *et al.*[37] and Barros.[38] Overall, the study of the 18 papers listed in Table 2 provides the acquisition of important knowledge in the subject area, thus it is an indispensable starting point for future research on the application of MCDM methods in the tourism domain.

At the end of the SNA analysis, the core and periphery elements of the paper citation network were presented in graph form (Fig. 9).

Out of a total of 220 elements in the network, 42 papers form its core. They are characterised by exceptional connectivity and above-average citation rates. It presents the core elements (designated in red) which hold the key to high cohesion and collaboration at the network level, as well as to better positioning and further development of the research area. The remaining 178 papers are peripheral elements whose importance should not be underestimated, especially given the fact that over time, due to the increase in citations, some peripheral elements are most likely to become part of the core of the network.

Content Analysis

While planning the content analysis procedure, 18 papers with the highest values of degree and betweenness centrality were taken into account from Table 2. However, as their position within the network is equally important, along with the number of citations and the frequency of individual papers acting as citation connector, 15 core papers with the highest values of degree and betweenness centrality were considered for the content analysis. These papers were perceived as being of crucial importance for the dissemination of knowledge and the intellectual structure of the network. Thus, Table 3 presents the content of the 15 papers which are of vital importance for the understanding of knowledge evolution within the subject area. For all papers, the analysis includes the following elements: the method used, the subject of application (sample size – number of observed DMUs) and the purpose of the application of a particular method, country (city) or geographical area where the research was conducted, major results of application of the method applied and the professional contribution of the paper.

It further demonstrates that DEA was applied in all 15 of the papers with the highest values of degree and betweenness centrality in a specific domain was in nine of 15 papers (60%) within the hotel industry. The method was generally intended for measuring and

Table 2 — Papers' ranking based on centrality metrics

| Paper	Degree centrality	Paper	Betweenness centrality
Hwang S N & Chang T Y, Using data envelopment analysis to measure hotel managerial efficiency change in Taiwan, *Tour Manag*, **24(4)** (2003) 357–369, https://doi.org/10.1016/S0261-5177(02)00112-7	58	Benito B, Solana J & López P, Determinants of Spanish regions' tourism performance: A two-stage, double-bootstrap data envelopment analysis, *Tour*, **20(5)** (2014) 987–1012, https://doi.org/10.5367/te.2013.0327	110.061
Barros C P, Measuring efficiency in the hotel sector, *Ann Tour Res*, **32(2)** (2005) 456–477, https://doi.org/10.1016/j.annals.2004.07.011	49	Tsai W H, Chou W C & Lai C W, An effective evaluation model and improvement analysis for national park websites: A case study of Taiwan, *Tour Manag*, **31(6)** (2010) 936–952, https://doi.org/10.1016/j.tourman.2010.01.016	93.000
Barros C P & Dieke P U C, Technical efficiency of African hotels, *Int J Hosp Manag*, **27(3)** (2008) 438–447, https://doi.org/10.1016/j.ijhm.2007.11.004	39	Ma X L, Ryan C & Bao J G, Chinese national parks: Differences, resource use and tourism product portfolios, *Tour Manag*, **30(1)** (2009) 21–30, https://doi.org/10.1016/j.tourman.2008.04.006	85.127
Barros C P, Botti L, Peypoch N, Robinot E, Solonandrasana B & Assaf A G, Performance of French destinations: Tourism attraction perspectives, *Tour Manag*, **32(1)** (2011) 141–146, https://doi.org/10.1016/j.tourman.2010.01.015	34	Oukil A, Channouf N & Al-Zaidi A, Performance evaluation of the hotel industry in an emerging tourism destination: The case of Oman, *J Hosp Tour Manag*, **29** (2016) 60–68, https://doi.org/10.1016/j.jhtm.2016.05.003	73.356
Chiang WE, Tsai MH & Wang LSM, A DEA evaluation of Taipei hotels, *Ann Tour Res*, **31(3)** (2004) 712–715, https://doi.org/10.1016/j.annals.2003.11.001	33	Oliveira R, Pedro MI & Marques RC, Efficiency and its determinants in Portuguese hotels in the Algarve, *Tour Manag*, **36** (2013) 641–649, https://doi.org/10.1016/j.tourman.2012.06.009	57.748
Hsieh L F & Lin L H, A performance evaluation model for international tourist hotels in Taiwan – An application of the relational network DEA, *Int J Hosp Manag*, **29(1)** (2010) 14–24, https://doi.org/10.1016/j.ijhm.2009.04.004	23	Barros CP, Measuring efficiency in the hotel sector, *Ann Tour Res*, **32(2)** (2005) 456–477, https://doi.org/10.1016/j.annals.2004.07.011	57.405
Köksal C D & Aksu A A, Efficiency evaluation of A-group travel agencies with data envelopment analysis (DEA): a case study in the Antalya region, Turkey, *Tourism Management*, **28(3)** (2007) 830–834. https://doi.org/10.1016/j.tourman.2006.05.013	22	Horng J S, Liu C H, Chou S F & Tsai C Y, Creativity as a critical criterion for future restaurant space design: developing a novel model with DEMATEL application, *Int J Hosp Manag*, **33** (2013) 96–105, https://doi.org/10.1016/j.ijhm.2012.06.007	54.450
Benito B, Solana J & López P, Determinants of Spanish regions' tourism performance: A two-stage, double-bootstrap data envelopment analysis, *Tour*, **20(5)** (2014) 987–1012, https://doi.org/10.5367/te.2013.0327	21	Peng H, Zhang J, Lu L, Tang G, Yan B, Xiao X & Han Y, Eco-efficiency and its determinants at a tourism destination: A case study of Huangshan National Park, China, *Tour Manag*, **60** (2017) 201–211, https://doi.org/10.1016/j.tourman.2016.12.005	52.148
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Yu M M & Lee B C Y, Efficiency and effectiveness of service business: Evidence from international tourist hotels in Taiwan, *Tour Manag*, **30(4)** (2009) 571–580, https://doi.org/10.1016/j.tourman.2008.09.005	19	Assaf A G, Benchmarking the Asia Pacific tourism industry: A Bayesian combination of DEA and stochastic frontier, *Tour Manag*, **33(5)** (2012) 1122–1127, https://doi.org/10.1016/j.tourman.2011.11.021	42.157
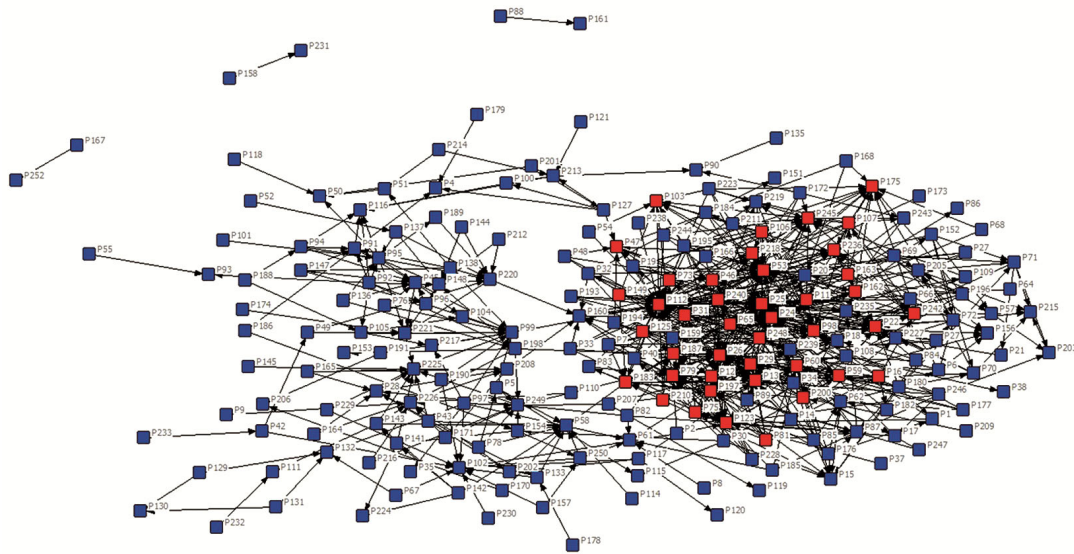
Fig. 9 — Core and periphery elements of the paper citation network

Table 3 — Content analysis of the most influential papers (Detailed references given in Table 2)

Authors, year & Method	Purpose	Country & Unit	Contributions
Hwang & Chang (2003) DEA	Managerial efficiency Performance evaluation	Taiwan Hotels (n = 45)	"there was a significant difference in efficiency change due to difference in sources of customers and management styles."; "...the managerial efficiency of international tourist hotels in Taiwan is related to the level of internationalization of hotels."
Barros (2005) DEA	Evaluation. Measuring performance (efficiency). Rationalization of operational activities.	Portugal Hotels – chained (n = 43)	Scale economies and location are designated as major issues in determining a unit's efficiency in Portugal or elsewhere. Provided benchmarks for improving the operations of inefficient hotels.
Barros & Dieke (2008) DEA	Estimating the economic drivers behind the technical efficiency	Angola (Luanda) Hotels (n = 12)	Efficiency has risen over the studied period, but at a decreasing rate. Hotel's membership in a group increases efficiency. Greater market share as measured by a Herfindahl index, increases efficiency. Hotels with an international strategy have higher efficiencies
Barros, Botti *et al.* (2011) DEA	Comparing performance (performance evaluation)	France Destination – tourism regions (n = 22)	The findings showed that there are several drivers of efficiency in French regions.
Chiang, Tsai & Wang (2004) DEA	Measuring hotel performance	Taiwan (Taipei) Hotels (n = 25)	"DEA has provided Taiwan's hotel operation with insights into resource allocation and competitive advantages. It also helps with strategic decision-making, especially regarding operational styles under intense competition through high hotel density."
Hsieh & Lin (2010) DEA	Analyzing the efficiency and effectiveness of ITHs in Taiwan	Taiwan Hotels (n = 57)	Recommended ways of enhancing the overall performance of the hotel industry in Taiwan. The first paper to apply the relational network DEA to construct a network performance evaluation model for the hotel industry in Taiwan.
Köksal & Aksu (2007) DEA	Evaluating the comparative operating efficiency	Turkey (Antalya) Travel agencies (n = 24)	There is no operating efficiency difference between the travel agency groups (*independently operating* and *operating under a chain brand*). Travel agencies and managers who scored low mean efficiency ratings were advised how to improve their rating.

(*Contd.*)

Table 3 — Content analysis of the most influential papers (Detailed references given in Table 2) (*Contd.*)

Authors, year & Method	Purpose	Country & Unit	Contributions
Benito, Solana & López (2014) DEA	Estimation the effect of a group of nine environmental factors on destination competitiveness	Spain Destination – regions (n = 17)	"The article contributes to the destination industry literature by adopting an approach that has not hitherto been applied to Spain."
Fuentes (2011) DEA	Analysis of travel agencies' relative efficiency	Spain (Alicante) Travel agencies (n = 22)	"Possible lines of action that the agencies can take in order to improve their efficiency in the future are provided."
Yu & Lee (2009) DEA	Appraisal of service performance in a service industry	Taiwan Hotels (n = 57)	"The results suggest that using the HNDEA approach to look inside a hotel's management provides greater insights as to the source of organizational inefficiency." "The concepts and methodologies could be applied to other service businesses across the world."
Oukil, Channouf, & Al-Zaidi (2016) DEA	Evaluating the performance of the hotel industry. Identification of potential sources of hotels' operational inefficiency	Oman Hotels (n = 58)	„the majority of hotels in Oman are technically inefficient; Most of the efficient hotels are located in the capital, Muscat; Star rating and cultural attractions are the most important factors influencing hotels' efficiency."
Oliveira, Pedro & Marques (2013) DEA	Comparing the efficiency of hotels with and without golf courses	Portugal (Algarve) Hotels (n = 84)	"Star rating is not a significant determinant of efficiency but location and the existence of golf courses may have some relevance." Hotels that do not possess golf courses are more efficient.
Peng, Zhang *et al.* (2017) DEA	Analysing the characteristics and evolution of eco-efficiency at an individual tourism destination	China National park Huangshan (n = 1)	Identified "the determinants of eco-efficiency." Indicated „that eco-efficiency has improved continuously." "Theoretical and practical contributions of the findings are discussed in the context of eco-efficiency at a tourism destination."
Ting & Huang (2012) DEA	Examining potential improvements in efficiency. Evaluating the effectiveness of the suggested mutual learning strategies between business and leisure hotels	Taiwan Hotels (n = 58)	The study demonstrated the value of benchmarking direct competitors, as both business and leisure hotels experienced positive effects by learning from their own type of hotel. However, mutual learning is effective for leisure hotels but not for business hotels.
Assaf (2012) DEA	Measuring and comparison of the efficiency (benchmarking analysis)	Asia Pacific countries (n = 12) Tour operators (n = 65); Hotels (n = 192)	Showed that "Australia, Singapore and South Korea are the most efficient in both their tour operator and hotel industries." International hotels in the region have a slightly higher efficiency than local ones. Provided "a listing of the most efficient tour operators and hotels in each country."

evaluating their performance, of which the most dominant factors were room service and Food & Beverage (F&B) services.

Content Analysis of Country Collaboration Papers

Table 4 presents the brief content analysis of papers where authors from different countries collaborated whereas only 2 or more collaborative papers were taken into consideration.

The Future of the Research Area

Artificial neural networks were deployed with the aim of predicting the number of papers in the given journals in the future. The methodology used involves certain conventional steps, such as data collection and selection (within which data in papers from the journal of tourism were gathered), pre-processing and transformation of data, creation, evaluation and testing of neural network models and interpretation of the results. The neural networks model is shown in Fig. 10.

Neurons in the hidden layer use a sigmoid function $f(x) = \frac{1}{1+e^x}$, which converts the input in the interval $(-\infty, +\infty)$ to interval $(0, 1)$. Output layer neurons use linear activation function and represent the attribute

Table 4 — Content analysis of the papers where authors from different countries collaborated

|		
China-USA	7	The territory of China, as well as hubs and hotels, were mostly analyzed in terms of their assessment, primarily in terms of efficiency, with AHP (for hubs) and DEA (for hotels). Smart tourism attractions and eco-efficiency destinations (national parks) appear in one paper each.
USA-Australia	5	DEA was used in all 5 papers. Most of the papers analyzed hotels (4) and efficiency/performance (4). Territories covered were Australia (3), China (1) and Slovenia (1).
USA-Portugal	4	DEA was used in all 4 papers. Bootstrap is present in most papers. Hotels were analyzed in two papers, and travel agent and destination/attraction in the others. The territory of the analysis is different and includes Angola, Taiwan, Portugal and France.
USA-Republic of Korea	3	Restaurants were analyzed in two papers: 1) the restaurant choice model and 2) the significance of the brand/franchise (Pacific rim). One paper focuses on the quality standards of rural farm accommodation (South Korea). MADM, DEA and AHP were used.
China-New Zealand	2	In both papers DEA was used and Chinese national parks were analyzed.
USA-UK	2	DEA was used in both papers. One paper is of a review nature regarding performance modeling in tourism research, and the other is related to the performance of Australian restaurants.
Spain-South Africa	2	Both papers analyzed South Africa. One paper relates to tourist satisfaction with destinations, and the other to measuring service quality in national parks.
UK-Italy	2	Hotels were analyzed from the aspect of customer ratings (online reviews).
Italy-Netherland	2	Decentralization of tourism sector (policy) and tourism competitiveness of destinations were analyzed on the example of Italy.
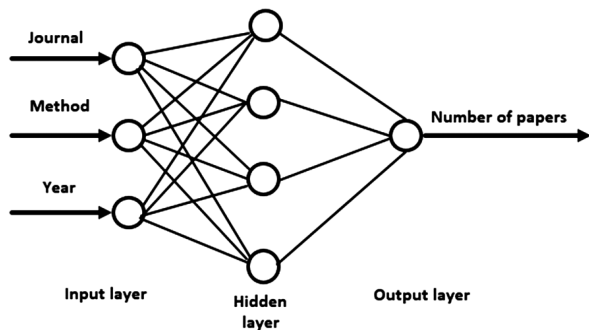
Fig. 10 — Neural network mode

values that were predicted (the number of papers). In order to train the neural network, a back-propagation algorithm was used. In order to evaluate the model, 30% and 70% of data was used for testing and training the neural network respectively. A similar approach was used in other studies by the authors of this paper but in different areas of application.[23–25] The root mean square error was calculated in accordance with Eq. (1)[39] which is used to, obtain the RMSE – the relationship between the total error of the model created and an unintelligent predictor: the lower the RMSE (below one), the greater the precision of the model.

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=0}^{n-1}(t_i - o_i)^2} \qquad \ldots (1)$$

t_i refers to the calculated output given by the network, o_i is the real output for case i, and n is the number of cases in the sample.

Neural network testing was conducted via DMX queries in order to predict new data not available in the current database. In the following query, the input data were as follows: the year 2021, the DEA method (code 9) and Tourism Management magazine (code 18).

SELECT
[MCDM].[Number],
Predict([Number])
From
[MCDM]
NATURAL PREDICTION JOIN
(SELECT
9 AS [Method],
2021 AS [Year],
18 as [Journal]) AS t

The result 1 is obtained from the analysis of the query, which infers that in the specified journal, in the year of 2021, one paper will use the DEA method. Due to the fact that 2021 concluded in the time between the research process and the initial submission of the paper to the journal, a manual check determined that the prediction made through the ANN model was correct and that one paper using the DEA method was published in the journal Tourism Management – Choi *et al.*[40]

Conclusions

The key contribution of this paper is that it is the first review paper on the application of MCDM methods which are focused only on the domain of tourism. The advantage of this paper over other review papers is that it establishes the overall history of a particular research area as opposed to papers that are limited to only a specific period of time. It is also important to emphasise that the journals searched

represent a clearly rounded whole and the papers published in them represent cutting-edge achievements in science within a particular research field.

The very list of papers included in the sample (n = 252) allows this paper to be considered as a form of 'database' in the interdisciplinary field of the application of MCDM in tourism, while the 18 papers obtained with SNA form the basis of the cutting-edge knowledge in the domain of tourism, providing a starting point for all future research in this area.

Future research could focus on a detailed analysis of papers for the most commonly used MCDM methods (primarily DEA), which could identify the specificities of these methods relative to the domain of tourism to which they are applied.

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