

Multi Criteria Decision Analysis (MCDA) to Support Decision Making in Tourism: A Bibliometric Review

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Keywords: Multi Criteria Decision Analysis, Support Decision Making, Tourism.

Abstract: Strategic management of complex decision-making problems in the tourism sector requires the implementation of appropriate planning procedures for sustainable tourism activities, taking into account the many factors involved such as variables and stakeholders and conflicting objectives. Decision support systems apply computer technology to create analytical methods and logical solutions, digitize, and program logic judgment programs into computers. Decision Support Systems (DSS) are used to help decision makers deal with complex problems or situations considering that human perception and intelligence can often reach their limits when faced with complex systems that generate lots of data with lots of dependencies. Based on this, this study conducted a bibliometric analysis on previous research discussing MCDA in tourism issues published from 2010 to 2022. Article identification was carried out through a scientific database literature search that was categorized by year of publication, research topics with the keywords MCDA, MCDM and Tourism. The results of the analysis show that further research is needed, within jurisdictions, to choose the most appropriate MCDA method to be applied to tourism because even in the last few decades multi-criteria decision analysis techniques have been widely used in the tourism sector such as the AHP, TOPSIS, ELECTRE, MACBETH, ANP methods, VIKOR and not a few new methods in the multi-criteria decision analysis technique approach have emerged, with different popularity and success but until now there are no guidelines or approaches to selecting the most appropriate MCDA method to be applied in tourism. Therefore, further research needs to identify methods in the multi-criteria decision analysis technique that can achieve the best compromise solution among the most relevant destinations in complex problems such as tourism.

1 INTRODUCTION

Productivity growth in the digital economy era is one of the most important sources of economic development. The information and communication technology (ICT) sector is important in terms of innovation and increased productivity by leveraging artificial intelligence, big data and computerized information (Nakatani, 2021). ICTs have been recognized for their role as an innovative stimulus that can enhance economic and social development at various levels, both in developing and least developed countries (Wang et al., 2021). ICT use which is the spirit in this era conditions humans personally and in organizational groups to rely heavily on computer-based management (Computer Based) which is increasingly advanced, complex and smart (Okano, 2017). As a result, from information generation to information communication, smartness is required in every action. Smartness facilitates the formation of products, ac-

tions, processes and services in real-time, by engaging various stakeholders simultaneously to optimize performance and competitiveness (Liu et al., 2012). Usually, the term smart is associated with fast and quick results, so that the use of ICT into artificial intelligence, data mining into computerized information becomes a place of choice to help provide information for decision makers known as Decision Support Systems (DSS) or Decision Support Systems (DSS).

Development Decision Support System (DSS) is a complex multi-stage process that requires considerable effort from a methodical and technical point of view (Ponomarev and Mustafin, 2021). A decision support system (DSS) has been developed on the basis of an information management system, applying computer technology to create analysis methods and logical solutions, digitizing and programming logic assessment programs into computers (Yun et al., 2021). A Decision Support System (DSS) is also defined as an interactive computer-based system in-

tended to help decision makers utilize data and models to identify and solve problems and make decisions (Bohanec et al., 2021). DSS incorporate data and models, designed to assist decision makers in semi-structured or unstructured tasks. In principle, DSS does not make decisions on its own, but supports human judgment by providing appropriate, accurate and timely information, relevant to the problem at hand. This information may include suggestions about possible courses of action. Decision Support Systems (DSS) refers to computerized multidimensional data management systems that support stakeholders in leveraging modern data-driven approaches to identify and solve problems and enable better decision making (Talari et al., 2021). Benchmark analysis of several alternative configurations can be facilitated by setting up a decision support system (DSS) where comparisons of different criteria are made directly (Južnic-Zonta et al., 2022). Decision support systems with technical comparisons of different criteria are also Multi Criteria Decision Analysis (MCDA), MCDA/MCDM is often used to solve real-world problems with multiple, conflicting, and disproportionate criteria and/or objectives (El-Aghoury et al., 2021). In the 1960s, the first multi-criteria decision making (MCDM) technique was developed to facilitate the difficulty in adapting disparate ideas and managing large amounts of complex information in the decision-making process (Seyedmohammadi et al., 2018) and a growing research field that has been studied for over 30 years (Hites et al., 2006) developed to facilitate the decision-making process (Yelmikheiev and Norek, 2021).

Multi-criteria decision analysis (MCDA) is a highly productive tool that is recognized globally for dealing with complex decision problems. It is the most appropriate tool for solving problems where the solution is based on several characteristics. Breaking the decision problem into smaller parts that are easier to understand. It then analyzes each part separately, and finally integrates all the parts to build a meaningful solution (Kumar et al., 2022) and is a branch of operations research and management science that the discipline uses to deal with the optimal allocation of scarce resources among competing activities by maximizing the desired benefits or minimizing the detrimental effects using mathematical models (Sun et al., 2020), (Mardani et al., 2015), (Erdogan et al., 2019) which discusses promising alternatives for dealing with complex decision-making problems that feature multiple, highly diverse, and conflicting goals (Talari et al., 2021), the multi-criteria method can provide supporting tools in policy and decision making processes by providing flexibility (Çelikkbilek and

Tüysüz, 2016). Uncertainty is a very important aspect in the process of multiple decision analysis criteria (MCDA) (Chen, 2020). MCDA enables decision makers to break down complex problems into simpler and essential components, facilitates the amalgamation and integration of the knowledge of multiple decision makers with various expertise, and supports collaborative problem solving and consensus building, especially when there are conflicts, experiences or views (Wilkins et al., 2022). The MCDA Method provides a framework for collecting, storing, and processing all relevant information characterized by social, political, environmental, and economic value judgments. The MCDA method can alleviate problems caused by limited human computing power where intuitive or adaptive choices are replaced by mutually justifiable and accepted models; in MCDA, there are usually DMs with conflicting preferences (Barney et al., 2022), this is supported by research (Baltazar et al., 2014) who concluded that Multi Criteria Decision analysis (MCDA), or Multi Criteria Decision Making (MCDM), is a decision making tool aimed at supporting decision makers who are faced with many conflicting evaluations. MCDA assists in the decision making process for complex spatial problems with reasonable accuracy (Das and Pal, 2020), is a mathematical instrument that assesses several competing criteria to provide the best alternative among many possibilities (Singh et al., 2022). MCDA is an important component of sustainability assessment tools because it allows to assess the uncertainties associated with the data used and also identifies the relevance and/or importance of each criterion used in a sustainability assessment. The MCDM method can overcome the problem of high variability, consider various objectives and attributes, analyze quantitative and qualitative parameters, and consider various interests and perspectives (Ma et al., 2022). MCDM is a branch of the general class of operations research models that deal with decision problems under the presence of many factors and criteria (Sakthivel et al., 2015), the basic purpose of MCDM is to help decision makers choose the best option from possible alternatives in cases with a large number of criteria, and also to state which criteria take precedence (ç. Kaptan Ayhan and Taşlı, 2020). Leveraging the MCDM methodology helps overcome the limitations of a more singular methodology. For example, when applying the analytical hierarchical process (AHP) method, all evaluation criteria and subcriteria must be independent of one another (Ma et al., 2022). Among the various techniques, the Multi Criteria dimensional analysis (MCDA) method makes it possible to simultaneously deal with many issues related to tourism policy mak-

ing (Arbolino et al., 2021).

The tourism sector has not only enjoyed significant growth in recent years, tourism has also become a source of wealth for the global economy, increasing income-based competition among tourist destinations (Carayannis et al., 2018). The tourism sector as a global economic driver, together with the broad agreement to operate under the principle of sustainability and the difficulties encountered in its implementation make the measurement of tourism sustainability a rather challenging topic for researchers and academics. Research related to tourism has been intensively carried out over the last few decades such as research by (Vecchio et al., 2018) who make use of big data in smart tourism destinations by utilizing interview data with a Business Analysis approach, the results of the study show an application of a data-based business model that can combine the benefits derived from the big data domain, both in terms of methodology and technology, with the demand for tourism experience that is more personalized and co-created and concludes that analyzing digital local experiences enables a more direct understanding of the potential offered by digital technologies for the intelligent configuration of tourism destinations. The findings also highlight the need to consolidate experience and develop regional offerings of knowledge-intensive business services (decision making, customer relations, and business analysis).

Conceptually, decision-making in tourism is no different from decision-making in other fields. In fact, the allocation of limited resources between competing alternatives and interests occurs every day in various fields. The main problem in the field of tourism is the many variables and stakeholders involved, where each variable and stakeholder has different goals and can conflict with each other but are interdependent on one another. Such as the number of visits that will affect the quality of the environment and the level of congestion. These complex features make it difficult for decision makers to make the right choice.

From the literature, several studies were found using review techniques in the application of the MCDM method, such as research by (Emovon and Ogheniyerovwho, 2020), This paper presents a methodical review of the application of the Multi-Criteria Decision Making (MCDM) method in material selection by reviewing a total of 55 papers, published from 1994-2019. Another review combining MCDM methods with building information modeling (BIM) in the architecture, engineering, and construction industries using the earliest literature 2009 to the year the research was conducted (Tan et al., 2021). A bibliometric analysis of MCDA in health was con-

ducted in 2012, this paper documents the application of MCDA in healthcare and aims to identify publication patterns as well as the various topics to which MCDA has been applied, a bibliometric analysis was carried out on articles reporting on MCDA application in healthcare published from 1960 until 2011 (Diaby et al., 2013). Still in the health sector, a systematic literature review was conducted on MCDA in decision making in health services. This study aims to provide a comprehensive overview of MCDA studies conducted to inform decisions in healthcare and to summarize its applicability in different decision contexts updating a systematic review conducted in 2013 by searching Embase, MEDLINE, and Google Scholar for MCDA studies in the field of health, published in English between August 2013 and November 2020 (Gongora-Salazar et al., 2022). The last review was conducted on the application of MCDM in the COVID-19 pandemic, this paper aims to review 72 papers published in 37 leading peer-reviewed journals indexed on the Web of Science that used the MCDM method in various regions of the COVID-19 pandemic (Sotoudeh-Anvari, 2022).

Over the last decade, a large number of methods have emerged, with varying popularity and success. One of the most prominent in the international literature is VIKOR, along with other 'classic' methods such as TOPSIS, PROMETHEE, AHP, ELECTRE, etc (Papathanasiou, 2021). However, until now, there are no guidelines or approaches to selecting the most appropriate MCDA method to be applied in tourism. We also wanted to identify publication trends in the application of MCDA in tourism as well as research topics that have been applied. Therefore, a bibliometric analysis was carried out to analyze the frequency of occurrence of MCDA applications in tourism. Where tourism policy makers reveal a large set of heterogeneous goals to be achieved through the allocation of public resources (Arbolino et al., 2021), this is an opportunity for researchers to approach the MCDA on the topic of tourism.

Given the many variables involved, the optimal solution is difficult to identify. Therefore, the MCDA technique aims to identify combinations of alternatives to be modified, in order to achieve the best compromise solution. Intended to achieve the best compromise solution among the most relevant objectives, thus overriding the "optimality" paradigm.

The next section will provide a presentation on the methodology, the third section will provide a brief overview of the relevant literature. The fourth section provides an overview of the implications of the limitations of the study and finally concludes the paper with a discussion of the main implications of the research,

which offer opportunities for further research.

2 MATERIALS AND METHODS

Evaluation of sustainable tourism is a complex endeavor involving many stakeholders who often have different perspectives. Therefore, various authors have drawn attention to the potential contribution of MCDA techniques to sustainability assessments in the tourism sector.

This paper uses bibliometric analysis to describe and analyze trends and publication patterns with the MCDA approach that appear on the topic of tourism. Data identification in citations was carried out by searching scientific literature data in the ScieDirect database based on the year of publication, namely research in the period 2010 to 2022 and research topics with the keywords MCDA, MCDM and Tourism.

From the literature search, basic information such as bibliography, including titles and abstracts will be analyzed, then filtered for relevance. Studies that are reviewed and those deemed out of scope (dealing with the application of MCDA in areas other than tourism) will be rejected. The remaining complete papers that are within scope are perused.

3 STUDY LITERATURE

Research by (García-Melón et al., 2012) conducting evaluations of sustainable tourism strategies promoted by stakeholders related to National Parks (NPs) is a major concern for park managers. This study aims to find a balance between economic, social and environmental factors and involve stakeholders. In assisting their research strategic evaluation procedures, a methodology based on the Analytic Network Process (ANP) and Delphi type assessment procedures was proposed. This methodology was applied to Los Roques NP in Venezuela. The problem includes three sustainable tourism strategies defined by stakeholders namely: eco-friendly resorts, eco-friendly leisure activities, and ecological transportation systems. Representatives from eight stakeholders participated in this methodology, 13 sustainability criteria were selected. It was concluded that regarding the use of the ANP-Delphi joint approach as a tool for prioritization, 2 experts stated that the first meeting to define and agree on criteria was successful because it allowed them to think about what they actually expected from the prioritization procedure. All stakeholders felt that the ANP procedures enabled them to deal with prioritization in an organized and systematic manner. How-

ever, they did not find it completely satisfactory or easy to understand until they had gone through the Delphi round and had the possibility that stakeholder assessments differed markedly after the Delphi round stabilized. So that the weaknesses of the ANP method in tourism problems that want to be improved in this study have not been achieved. It was concluded that regarding the use of the ANP-Delphi joint approach as a tool for prioritization, 2 experts stated that the first meeting to define and agree on criteria was successful because it allowed them to think about what they actually expected from the prioritization procedure. All stakeholders felt that the ANP procedures enabled them to deal with prioritization in an organized and systematic manner. However, they did not find it completely satisfactory or easy to understand until they had gone through the Delphi round and had the possibility that stakeholder assessments differed markedly after the Delphi round stabilized. So that the weaknesses of the ANP method in tourism problems that want to be improved in this study have not been achieved. It was concluded that regarding the use of the ANP-Delphi joint approach as a tool for prioritization, 2 experts stated that the first meeting to define and agree on criteria was successful because it allowed them to think about what they actually expected from the prioritization procedure. All stakeholders felt that the ANP procedures enabled them to deal with prioritization in an organized and systematic manner. However, they did not find it completely satisfactory or easy to understand until they had gone through the Delphi round and had the possibility that stakeholder assessments differed markedly after the Delphi round stabilized. So that the weaknesses of the ANP method in tourism problems that want to be improved in this study have not been achieved.

Further research by (R. S. Estevao and e, 2019) who concluded that despite the increasing interest in sustainable tourism (ST), the actual implementation of sustainability practices in the tourism sector is still sporadic. The research proposes a decision-making process in the MCDA context. The decision-making process in the MCDA context is by implementing the JOURNEY Making approach at the structuring stage and CI at the evaluation stage. The proposed method and model have some limitations as in the context of this study, our reliance on a panel of experts, although advantageous, represents a major research challenge largely due to the experts' conflicting agendas and time-consuming sessions. In addition, the ease with which it is necessary to recruit experts within a close geographic distance also influences the panel selection process.

To reduce the adverse impact on the environment

caused by conventional (mass) Tourism, the importance of ecotourism is increasingly being highlighted as this form of tourism contributes to environmental protection and sustainable development of an area (L. Gigovic and S., 2016). The main objective of this research is the development of a reliable model for the identification of zone suitability for sustainable ecotourism development, which will be a significant support for planners in ecotourism development and management strategies. The proposed model is based on the combined application of a Geographic Information System (GIS) and Multi-Criteria Decision Analysis (MCDA) using the Fuzzy Decision Making Trial and Evaluation Laboratory (FDEMATEL) method to estimate and map ecotourism potential suitability classes in the study area "Dunavski ključ" (Serbia). The research results contribute to the theoretical framework for selecting suitable sites but note that this model highlights new criteria that have not been considered in ecotourism models but are significant for this issue. It is important to note that the criteria applied for the selection of areas for ecotourism development vary by region and depend on current socio-economic and natural resources. Therefore, this procedure allows for other criteria that have not been included in this study. All of these factors will have additional importance in finding the best solution.

This research (ç. Kaptan Ayhan and Taşlı, 2020) carry out a land use suitability analysis for activities for rural tourism by following the steps of the ELECTRE I method. This study did not provide clear results on the land suitability analysis for rural tourism using the ELECTRE I method. This study only focuses on the research topic, namely tourism development, so the performance level of the MCDA method used in the research is unknown.

The accelerating interaction between technology and tourism has radically changed the efficiency and effectiveness of tourism organizations, as well as how consumers interact with organizations. This research offers a web-based intelligent framework for travel agencies proposed that offers fast and reliable response services to customers in a less costly manner. The proposed framework integrates a case-based reasoning system (CBR) with a multi-criteria decision-making technique (MCDM), namely the Analytic Hierarchy Process (AHP), to increase accuracy and speed in case matching in tourism destination planning. The integration of the two techniques makes it possible to capitalize on their strengths and complement each other's weaknesses. The results conclude that rule-based planning does not work well when the customer's filtering preferences are unclear or even

change for the time being according to the customer's changing context. Therefore, it is not a suitable technique for tourism planning where decisions are influenced by seasonal effects, from last year's climate, from last year's popular region or the business relationships of agents. The system in the tourism management system must be flexible (Alptekin and Büyüközkan, 2011).

The application of a new approach to the selection of projects to be funded by public administration, to maximize the efficiency of the allocation of public resources in tourism sustainability has been carried out using 2 MCDA methods namely Weighted sum and Analytic Hierarchic Process (Arbolino et al., 2021). The results of the study concluded that the application of multi-criteria techniques is not always sufficient, because none of them deal with budgetary constraints when used individually so it is hoped that further research may involve the application of optimization models in a broader Decision Support System, involving aspects, a set of the criteria and objectives included in the model can be modified.

Implementation of the application of the Multi-Criteria Decision Analysis (MCDA) ELECTRE I method to tourism destinations, research contributes to reflections on the competitiveness of tourism destinations which have bigger enthusiasts in recent years. The research concludes that this paper shows that the results of the ELECTRE I and the Weighted-Sum Method are different in this work so that this can be an opportunity for identifying future research (Botti and Peypoch, 2013).

A study that tries to resolve the limitations of pre-existing research regarding the selection of evaluation variables and the calculation of their respective weights in evaluating the competitiveness of tourist destinations by creating an evaluation index of several criteria for the competitiveness of tourist destinations, through the use of integrated cognitive maps and measuring attractiveness with measuring attractiveness by a categorical based evaluation technique (MACBETH). Research is only focused on tourist destinations in one region so that case studies in different regions require factor adjustments according to the needs of each region which are different, does not provide a clear analysis of the performance of the methods used, contributes methodologically and is related to the substantive results of the research (Carayannis et al., 2018).

Subsequent research that analyzes the sustainability of regional tourism in Spain (Carrillo and Jorge, 2017), in this paper a new procedure for the development of composite indicators for tourism sustainability analysis is proposed which uses a multicrite-

ria decision technique specially designed to deal with the concept of multidimensional nature and nearly incommensurable entities i.e. the CI method. The research results only describe some differences from existing aggregation methods, there is no logical review of the performance of the proposed approach.

Research in the tourism sector, especially on sustainable beach tourism which aims to identify factors that influence the coastal environment and build a multi-criteria evaluation structure for beach tourism using the Fuzzy Analytical Hierarchy Process (AHP) approach. The research results focus on the results of the analysis of tourism development. There were no results of the analysis of the method's performance on cases. So even though this study utilizes MCDA in tourism development, it has not yet provided results of an analysis of the performance of the method used. The research adds to the number of studies with similar topics but has not yet found an appropriate method format used in tourism issues (Chen and Bau, 2016).

The application of the Fuzzy Rasch model in the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was carried out to analyze the Tourism Destination Competitiveness (TDC) of nine Asian countries: China, Hong Kong, Japan, Korea, Malaysia, Singapore, Taiwan, Thailand and the Philippines. The research was conducted in 2009 using 6 criteria and 15 indexes. Conclusions are drawn exclusively from mathematical calculations, the results of the research focus on the results of the analysis of tourism development. There were no results of the analysis of the method's performance on cases. So even though this study utilizes MCDA in tourism development, it has not yet provided results of an analysis of the performance of the method used. The research adds to the number of studies with similar topics but has not yet found an appropriate method format used in tourism issues (Huang and Peng, 2012).

Subsequent studies present a new planning approach to develop a reliable model that identifies suitable and unsuitable locations for rural housing development planning in reservoir areas under tourism, presented here is a combined application of a geographic information system (GIS) and multi criteria decision analysis (MCDA) using the DEMATEL fuzzy method to create a suitability map for rural housing. The conclusion of the study stated that the application of the FDEMATEL-GIS/MCDA model for evaluating the potential of rural housing planning has proven positive and justified, because based on the adopted criteria, it succeeded in distinguishing parts of space that are highly suitable for sustainable and resilient rural housing planning. Sensitivity analysis by changing the group weight coefficients shows a high

level of model stability, but there is no comparison with other MCDA methods (Jeong et al., 2016).

This study presents a holistic approach to evaluating complex national tourism policies with hybrid MCDA to test the dependency relationship between various dimensions and criteria of tourism policy with DEMATEL-based analytic network process (DANP) and VIKOR. This study has a weakness, namely this research was conducted with a relatively expert sample group. A larger sample carrying more explanatory power will allow more sophisticated evaluation analyzes and verify the current findings to increase generalizability. Second, the evaluation criteria were selected from a literature review on the implementation of tourism policies, based on this it is known that the results of the analysis only focus on tourism development indicators (Ma et al., 2022).

Subsequent studies evaluating the selection of optimal tourist sites using ANP and fuzzy TOPSIS in the context of Integrated Coastal Zone Management: A case of Qeshm Island. The conclusion of the study states that in the case of selecting tourist sites, the proposed model has significantly increased the efficiency of the decision-making process, however to use algorithms to identify and evaluate important factors in economic and industrial development and by using modern scientific methods (Morteza et al., 2016).

Research in the tourism sector using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was applied to evaluate the competitiveness of tourism destinations (TDC) from the Yangtze River Delta in China. Although the results of the study concluded that the method that combines TOPSIS with IEW can evaluate complex monolayer index systems and multi-level index systems. This method avoids errors caused by using different methods and makes the evaluation process rigorous and rational but it cannot be said that this hybrid model is the most appropriate in tourism development (Zhang et al., 2011).

Various research works can be found in the literature that analyze the topic of sustainable tourism with the MCDA approach, such as:

1. Title: A combined ANPdelphi approach to evaluate sustainable tourism (García-Melón et al., 2012)
Method: Analytic Network Process (ANP)-Delphi
Conclusion :
The results of the study concluded that all stakeholders felt that the ANP procedure enabled them to handle prioritization in an organized and systematic manner however, they did not find it completely satisfactory or easy to understand before

- getting to Delphi's work.
2. Title: A socio-technical approach to the assessment of sustainable (R. S. Estevao and e, 2019) tourism: Adding value with a comprehensive process-oriented framework
Method: Cognitive Mapping and Choquet Integral (CI)
Conclusion :
The method and model proposed in this study have several limitations, such as dependence on expert panels. This provides recommendations for further research that allows replication of the method with different panels of experts or in other regions, thereby facilitating comparison between results and analyzes and increasing generalizability. Future studies may also wish to consider applying other methods and combinations within the MCDA approach
 3. Title: GIS-Fuzzy DEMATEL MCDA model for the evaluation of the sites for ecotourism development: A case study of "Dunavski kljuc" region, Serbia (L. Gigovic and S., 2016)
Method: Geographic Information Systems (GIS) dan Fuzzy Decision Making Trial and Evaluation Laboratory (FDEMATEL)
Conclusion :
The application of the GIS-FDEMATEL MCDA model in evaluating ecotourism potential has proven effective and justified because it has succeeded in distinguishing parts of the area and sensitivity analysis by changing the cluster weight coefficients has shown a high level of model stability but the indicators of the 4 division zones are not explained with certainty.
 4. Title: Land use suitability analysis of rural tourism activities: Yenice, Turkey (ç. Kaptan Ayhan and Taşlı, 2020)
Method: GIS - ELECTRE I
Conclusion :
The conclusion of this study only focuses on the target area of the literature, an assessment of the performance of the method has not been carried out so that the performance of the method in this study is not known.
 5. Title: An integrated case-based reasoning and MCDM system for Web based tourism destination planning (Alptekin and Büyüközkan, 2011)
Method: GAnalytic Hierarchy Process (AHP)
Conclusion :
The conclusion of the study states that the method used is not a suitable technique for tourism planning where decisions are influenced by seasonal effects, from last year's climate, from last year's popular region or business relations of agents.
 6. Title: Multi-objective optimization technique: A novel approach in tourism sustainability planning (Arbolino et al., 2021)
Method: Weighted sum dan Analytic Hierarchic Process (AHP)
Conclusion :
From the conclusion of the study it is stated that the application of multi-criteria techniques is not always sufficient, because none of them deal with budget constraints.
 7. Title: Multi-criteria ELECTRE method and destination competitiveness (Botti and Peypoch, 2013)
Method: LECTRE I dan Metode Weighted-Sum.
Conclusion :
The conclusion of this paper shows that the results of the ELECTRE I and the Weighted-Sum Method are different in this work.
 8. Title: The evaluation of tourism destination competitiveness by TOPSIS and information entropy e A case in the Yangtze River Delta of China (Zhang et al., 2011)
Method: Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
Conclusion :
Although the results of the study concluded that the method that combines TOPSIS with IEW can evaluate complex monolayer index systems and multi-level index systems. This method avoids errors caused by using different methods and makes the evaluation process rigorous and rational but it cannot be said that this hybrid model is the most appropriate in tourism development.

4 DISCUSSION

From previous studies that have been previously described regarding the MCDA approach in the tourism sector. The MCDA approach with various existing methods in identifying tourism is divided into many discussion focuses. This seems to have happened because in practice the tourism sector is not only about holidays, but in the tourism context there are many factors that require special attention for the purpose of tourism sustainability. Sustainability is meant not only from one factor but sustainability which can be concluded is how all the factors involved can work in balance. The factors involved in the tourism sector are seen as quite complex because they involve economic, social and environmental factors. If we examine more deeply the economic factors, social and environmental aspects in the tourism sector, of course there will

be many supporting variables for each factor, such as when we talk about economic factors in the tourism sector we don't only think about tourist location income but about regional, country, stakeholder and community economic income. It doesn't end here, the problem of even one factor has become very complex considering that the stakeholders involved conflict with each other and influence one another in achieving this economic goal. The problem of tourism becomes very complex when all factors and stakeholders are considered. In general, this is the background of much research in the tourism sector. like when we talk about economic factors in the tourism sector we don't only think about tourist location revenue but about regional, country, stakeholder and community economic income. It doesn't end here, the problem of even one factor has become very complex considering that the stakeholders involved conflict with each other and influence one another in achieving this economic goal. The problem of tourism becomes very complex when all factors and stakeholders are considered. In general, this is the background of much research in the tourism sector. like when we talk about economic factors in the tourism sector we don't only think about tourist location revenue but about regional, country, stakeholder and community economic income. It doesn't end here, the problem of even one factor has become very complex considering that the stakeholders involved conflict with each other and influence one another in achieving this economic goal. The problem of tourism becomes very complex when all factors and stakeholders are considered. In general, this is the background of much research in the tourism sector. the problem of even one factor has become very complex considering that the stakeholders involved conflict with each other and influence one another in achieving this economic goal. The problem of tourism becomes very complex when all factors and stakeholders are considered. In general, this is the background of much research in the tourism sector. the problem of even one factor has become very complex considering that the stakeholders involved conflict with each other and influence one another in achieving this economic goal. The problem of tourism becomes very complex when all factors and stakeholders are considered. In general, this is the background of much research in the tourism sector.

Taking into account the sustainability of tourism which is an important topic for the development of a country, many researches in this field are carried out. From the results of research searches in the tourism sector with the MCDA approach, research in this field is focused on several topics such as several studies

that seek to analyze the role of economic, social and environmental factors and the stakeholders involved with the aim of finding a balance between them, towards sustainable tourism increasing research previously tried to analyze and create an assessment model for sustainable tourism by applying the multiple criteria decision analysis (MCDA) method, whose main objective is to explicitly identify the relevant criteria and integrate them into the decision-making process. Considering that tourism sustainability involves the environment as a factor of sustainability, previous research has tried to carry out an analysis of environmental protection and sustainable development in tourist areas by identifying suitable locations or zones for sustainable ecotourism development. Not much different from identifying the most suitable zones for sustainable ecotourism development, most of the research topics described in the research seek to identify land, locations that are most suitable for tourism development aimed at stakeholders, identify the most popular tourist destinations as tourist destinations. In contrast to tourism location determination, research in this sector also seeks to model web-based intelligent frameworks with the aim of providing good service quality by prioritizing fast and reliable web-based responses and to improve accuracy and speed in case matching in tourism destination planning using MCDA. Related to the many factors involved in sustainable tourism, one of which is the economic factor, to reach the level of the economy to be achieved many studies also try to identify tourism competitiveness and are still limited to one particular area. And up here, research in the tourism sector also tries to assess the sustainability of tourism by considering indicators such as economic, social and environmental aspects and reducing them into several variables from each of these indicators. Identify factors that can affect tourism sustainability for certain tourism zones to determine sustainable tourism development that can be implemented.

It is known that in the tourism sector there are many interesting topics to study, even considering that each region has different factors, several studies with similar topics were carried out using the MCDA approach with different methods. As in determining the location, land or zone that is most suitable for sustainable tourism development, it is known that several methods have been used, such as TOPSIS, ELECTRE I, ANP, a combination of TOPSIS and ANP and the Fuzzy Decision Making Trial and Evaluation Laboratory (FDEMATEL). For the problem of sustainable tourism competitiveness the MCDA approach is carried out using the TOPSIS, MACBETH, ELECTRE I methods. In identifying the dependency re-

relationships between dimensions involved in sustainable tourism that influence each other, MCDA methods such as DEMATEL-based analytic network processes (DANP) and VIKOR and Analytic Network Processes (ANP) are used. Identify the factors that affect tourism sustainability using the Fuzzy Analytical Hierarchy Process (AHP) and CI approaches, selecting sustainable tourism projects to be developed using Weighted sum and Analytic Hierarchic Process (AHP) and modeling smart applications in tourism by integrating AHP with GIS.

Although the application of MCDA in tourism development has been quite intensely researched in the literature over the last few decades, until now there is no literature that provides guidelines or approaches for choosing the most appropriate MCDA method to be applied in tourism and tends to focus on indicators of tourism development, alternatives and some describe the weaknesses of the MCDA method which become opportunities for future research. This is certainly an opportunity to identify new models that can contribute to new mathematical models that can cover the weaknesses of the method which aims to identify alternative combinations to be modified to achieve the best compromise solution.

5 LIMITATION

This research may miss the non-English MCDA studies that have informed decisions in the tourism sector. Second, all searches were performed from only one database, namely ScienceDirect, for freely accessible publications, which may have influenced the identification of relevant studies. Third, our search criteria are less stringent, still in general with the search criteria MCDA, MCDM and Tourism published in 2010 to 2020, which risks missing relevant scientific studies before 2010 and after 2022.

6 CONCLUSIONS

Over the past few decades, tourism has experienced a continuous and rapid expansion, which can be beneficial for the economic development of the destination and its people. However, unplanned expansions put intense pressure on its goals and resources, even jeopardizing its long-term existence. Therefore, the need to support sustainability by planning tourism activities has attracted a lot of attention and given rise to a lively expansion of sustainable tourism. The application of MCDA in intensive tourism issues is carried out on research discussions where many interesting

topics are known to be studied, even considering that each region has varying factors, several studies with similar topics were carried out using the MCDA approach with different methods. As for the most suitable location, land or zone costs in the development of sustainable tourism, several studies have used various methods on MCDA such as TOPSIS, ELECTRE I, ANP, a combination of TOPSIS and ANP and the Fuzzy Decision Making Trial and Evaluation Laboratory (FDEMATEL). In the case of tourism competitiveness the application of MCDA is carried out using the TOPSIS, MACBETH, ELECTRE I methods. To analyze the interplay between the dimensions involved in tourism, the MCDA approach continues to be carried out with such as DEMATEL-based analytic network process (DANP) and VIKOR and Analytic Network Processes. (ANP) and analysis of factors influencing tourism sustainability with the Fuzzy Analytical Hierarchy Process (AHP) and CI approaches, selection of tourism projects to be developed using Weighted sum and Analytic Hierarchic Process (AHP) and modeling smart applications in tourism by integrating AHP with GIS. Even though the discussion on this issue is getting more intensive, the practical implementation of sustainable measures in the tourism sector is still inadequate, this is supported based on the literature which concludes future research opportunities in the hope of providing more perfect results in dealing with complex problems such as tourism and considering this situation, the methods performance appraisal related to sustainable tourism has emerged as a potential solution that can drive policy implementation and target sustainability. Various researchers have investigated this question, but acknowledge that some of these studies reveal that limitations still often exist and need to be addressed to provide a more robust model for the assessment of sustainable tourism. Evaluating tourism is complex not only because of its fuzzy boundaries but also because of its multidimensional character and being associated with multiple stakeholders who often have conflicting interests. Responding to these challenging characteristics can become future research opportunities that can deal with complex problems in the field of tourism which involve many tricks and involve many stakeholders from various fields, who oppose each other, have various goals but are interdependent on one another in the form of a model approach. new to MCDA. A new approach that can run more efficiently in the field of tourism so as to find a balance between economic, social and environmental factors which each involve many variables and stakeholders, proposes the MCDA method which has high suitability and completion, high level of sensitivity.

high and does not omit important information.

REFERENCES

- Alptekin, G. and Büyüközkan, G. (2011). An integrated case-based reasoning and mcdm system for web based tourism destination planning,"expert". *Systems with Applications*, 38:2125–2132.
- Arbolino, R., Boffardi, R., Simone, L., and Ioppolo, G. (2021). Multi-objective optimization technique: A novel approach in tourism sustainability planning. *Journal of Environmental Management*, 285:112016.
- Baltazar, M., Jardim, J., Alves, P., and Silva, J. (2014). Air transport performance and efficiency: Mcda vs. dea approaches. *Procedia - Social and Behavioral Sciences*, 111:790-799.
- Barney, A., Polatidis, H., and Haralambopoulos, D. (2022). Decarbonisation of islands: A multi-criteria decision analysis platform and application,"sustainable. *Energy Technologies and Assessments*, 52:102115.
- Bohanec, M., Tartarisco, G., Marino, F., Pioggia, G., Puddu, P., Schiariti, M., Baert, A., Pardaens, S., Clays, E., Vodopija, A., and Luštrek, M. (2021). Heartman dss: A decision support system for self-management of congestive heart failure. *Expert Systems with Applications*, 186:115688.
- Botti, L. and Peypoch, N. (2013). Multi-criteria electre method and destination competitiveness. *Tourism Management Perspectives*, 6:108-113.
- Carayannis, E., Ferreira, F., Bento, P., Ferreira, J., Jalali, M., and Fernandes, B. (2018). Developing a socio-technical evaluation index for tourist destination competitiveness using cognitive mapping and mcda. *Technological Forecasting and Social Change*, 131:147-158.
- Carrillo, M. and Jorge, J. (2017). Multidimensional analysis of regional tourism sustainability in spain. *Ecological Economics*, 140:89-98.
- Chen, C. and Bau, Y. (2016). Establishing a multi-criteria evaluation structure for tourist beaches in taiwan: A foundation for sustainable beach tourism. *Ocean and Coastal Management*, 121:88-96.
- Chen, T. (2020). New chebyshev distance measures for pythagorean fuzzy sets with applications to multiple criteria decision analysis using an extended electre approach. *Expert Systems with Applications*, 147:113164.
- Das, B. and Pal, S. (2020). Sciencedirect irrigation practices causing vulnerability of groundwater resources in water scarce goghat-i and ii blocks of hugli district using mcda , ahp , fuzzy logic and novel ensemble models. *Advances in Space Research*, 65:2733-2748.
- Diaby, V., Campbell, K., and Goeree, R. (2013). Multi-criteria decision analysis (mcda) in health care: A bibliometric analysis. *Operations Research for Health Care*, 2:20-24.
- El-Aghoury, M., Ebid, A., and Mahdi, I. (2021). Decision support system to select the optimum steel portal frame coverage system. *Ain Shams Engineering Journal*, 12:73-82.
- Emovon, I. and Oghenyerovwho, O. (2020). Application of mcdm method in material selection for optimal design: A review. *Results in Materials*, 7:100115.
- Erdogan, S., Balki, M., Aydın, S., and Sayin, C. (2019). The best fuel selection with hybrid multiple-criteria decision making approaches in a ci engine fueled with their blends and pure biodiesels produced from different sources. *Renewable Energy*, 134:653-668.
- García-Melón, M. and Gómez-Navarro, T. and Acuña-Dutra, S.(2012). A combined anp-delphi approach to evaluate sustainable tourism. *Environmental Impact Assessment Review*, 34:41-50.
- Gongora-Salazar, P., Rocks, S., Fahr, P., Rivero-Arias, O., and Tsiachristas, A. (2022). The use of multicriteria decision analysis to support decision making in healthcare: An upyeard systematic literature review. *Value in Health*.
- Hites, R., Smet, Y., Risse, N., Salazar-Neumann, M., and Vincke, P. (2006). About the applicability of mcda to some robustness problems,"european". *Journal of Operational Research*, 174:322-332.
- Huang, J. and Peng, K. (2012). Fuzzy rasch model in topsis: A new approach for generating fuzzy numbers to assess the competitiveness of the tourism industries in asian countries. *Tourism Management*, 33:456-465.
- Jeong, J.S., García-Moruno, L. and Hernández-Blanco, J. and Sánchez-Ríos, A. (2016). Planning of rural housings in reservoir areas under (MASS) tourism based on a fuzzy dematel-gis/mcda hybrid and participatory method for alange, spain. *Habitat International*, 57:143-153.
- Južnic-Zonta, Ž., Guisasola, A., and Baeza, J. (2022). Smart-plant decision support system (sp-dss): Defining a multi-criteria decision 'making framework for the selection of wwtp configurations with resource recovery. *Journal of Cleaner Production*, 367.
- Kumar, P., Sharma, R., and Bhaumik, S. (2022). Mcda techniques used in optimization of weights and ratings of drastic model for groundwater vulnerability assessment. *Data Science and Management*, 5:28-41.
- L. Gigovic, D. Pamučar, D. Lukič and S. (2016). Marković, GIS-Fuzzy DEMATEL MCDA model for the evaluation of the sites for ecotourism Development: A case study of 'Dunavski ključ' region, Serbia. *Land Use Policy*, Dec. 2016, 58:348-365.
- Liu, C., Tzeng, G., and Lee, M. (2012). Improving tourism policy implementation - the use of hybrid mcdm models. *Tourism Management*, 33:413-426.
- Ma, W., Du, Y., Liu, X., and Shen, Y. (2022). Literature review: Multi-criteria decision-making method application for sustainable deep-sea mining transport plans. *Ecological Indicators*, 140:109049.
- Mardani, A., Jusoh, A., Nor, K., Khalifah, Z., Zakwan, N., and Valipour, A.(2015). Multiple criteria decision-making techniques and their applications - A review of the literature from 2000 to 2014. *Economic Research-Ekonomska Istrazivanja*, 28:516-571.

- Morteza, Z., Reza, F., Seddiq, M., Sharareh, P., and Jamal, G. (2016). Selection of the optimal tourism site using the anp and fuzzy topsis in the framework of integrated coastal zone management: A case of qeshm island. *Ocean and Coastal Management*, 130:179-187.
- Nakatani, R. (2021). Total factor productivity enablers in the ict industry: A cross-country firm-level analysis. *Telecommunications Policy*, 45:102188.
- Okano, M. (2017). Iot and industry 4.0: The industrial new revolution. In *ICMIS-17 - International Conference on Management and Information Systems*, page 75-82.
- Papathanasiou, J. (2021). An example on the use and limitations of mcda: The case of fuzzy vikor. *Examples and Counterexamples*, 1:100001.
- Ponomarev, A. and Mustafin, N. (2021). Decision support systems configuration based on knowledge-driven automated service composition: Requirements and conceptual model. *Procedia Computer Science*, 186:654-660.
- R. S. Estevao, F. A. Ferreira, Á. A. R. K. G. and e, I. M.-K. E. (2019). A socio-technical approach to the assessment of sustainable tourism: Adding value with a comprehensive process-oriented framework. *Journal of Cleaner Production*, 236.
- Sakthivel, G., Ilankumaran, M., and Gaikwad, A. (2015). A hybrid multi-criteria decision modeling approach for the best biodiesel blend selection based on anp-topsis analysis. *Ain Shams Engineering Journal*, 6:239-256.
- Seyedmohammadi, J., Sarmadian, F., Jafarzadeh, A., Ghorbani, M., and Shahbazi, F. (2018). Application of saw, topsis and fuzzy topsis models in cultivation priority planning for maize, rapeseed and soybean crops. *Geoderma*, 310:178-190.
- Singh, S., Kawade, S., Dhar, A., and Powar, S. (2022). Analysis of mango drying methods and effect of blanching process based on energy consumption, drying time using multi-criteria decision-making. *Cleaner Engineering and Technology*, 8:100500.
- Sotoudeh-Anvari, A. (2022). The applications of MCDM methods in covid-19 pandemic: A state of the art review. *Applied Soft Computing*, 126:109238.
- Sun, Y., Lin, P., and Higham, J. (2020). Managing tourism emissions through optimizing the tourism demand mix. *Concept and analysis, Tourism Management*, 81:104161.
- Talari, G., Cummins, E., McNamara, C., and O'Brien, J. (2021). State of the art review of big data and web-based decision support systems (dss) for food safety risk assessment with respect to climate change. *Trends in Food Science and Technology*.
- Tan, T., Mills, G., Papadonikolaki, E., and Liu, Z. (2021). Combining multi-criteria decision making (mcdm) methods with building information modelling (bim): A review. *Automation in Construction*, 121.
- Vecchio, P., Mele, G., Ndou, V., and Secundo, G. (2018). Creating value from social big data: Implications for smart tourism Destinations, Information. *Processing and Management*, 54:847-860.
- Wang, D., Zhou, T., Lan, F., and Wang, M. (2021). Ict and socio-economic development: Evidence from a spatial panel Data analysis in china. *Telecommunications Policy*, 45:102173.
- Wilkins, C., Rychert, M., Queirolo, R., Lenton, S., Kilmer, B., Fischer, B., Decorte, T., Hansen, P., and Omblor, F. (2022). International journal of drug policy assessing options for cannabis law reform : A multi-criteria decision analysis (mcda) with stakeholders in new zealand. *International Journal of Drug Policy*, 105:2-10.
- Yelmikheiev, M. and Norek, T. (2021). Comparison of mcda methods based on distance to reference objects - a simple study case. *Procedia Computer Science*, 192:4972-4979.
- Yun, Y., Ma, D., and Yang, M. (2021). Human-computer interaction-based decision support system with Applications in data mining. *Future Generation Computer Systems*, 114:285-289.
- Zhang, H., Gu, C., Gu, L., and Zhang, Y. (2011). The evaluation of tourism destination competitiveness by topsis information entropy - a case in the yangtze river delta of china. *Tourism Management*, 32:443-451.
- Ç. Kaptan Ayhan, T. Cengiz Taşlı, F. Özkök and Tatlı, H. (2020). Land use suitability analysis of rural tourism activities: Yenice, turkey. *Tourism Management*, 76.
- Çelikbilek, Y. and Tüysüz, F. (2016). An integrated grey based multi-criteria decision making approach for the evaluation of renewable energy sources. *Energy*, 115:1246-1258.