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A novel advertising media selection framework for online games in an intuitionistic fuzzy environment

JEL Classification: *C51; C61; D81; E27; M31; M37; O41*

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Abstract

Research background: The critical role of online games in e-commerce and the great competition among providers to enhance market share has significantly increased the need to use effective advertising patterns, techniques, and tools to attract users. There are two significant challenges to planning online media game selection. The first challenge is that there is no agreement on media selection criteria for online game advertising. The second challenge relates to the complexity of choosing advertising media.
Purpose of the article: Given the multidimensionality and uncertainty in evaluating and selecting advertising media, especially in the case of online games, the need to provide a systematic framework for evaluating and selecting media is critical.
Methods: The present study aims to provide a systematic framework based on multi-attribute decision-making (MADM) methods to evaluate and select the appropriate media for online game advertising. For this purpose, first, by reviewing the literature, a relatively comprehensive list of media selection criteria for online game advertising was extracted and then provided to experts in online game marketing and advertising in the fuzzy Delphi questionnaire. Then, based on their opinions, a localized decision model was obtained. Also, the Step-wise Weight Assessment Ratio Analysis (SWARA) method helped to determine the criteria' importance. In the next step, a preliminary list of online game advertising media was prepared and evaluated by experts based on the criteria obtained in the previous step. Finally, the media was ranked using the Additive Ratio ASsessment (ARAS) method.
Findings & value added: Awareness of the criteria affecting the selection of online game advertising media and having a systematic framework for applying these criteria in advertising media selection decisions play a vital role in practical decisions. This research addresses one of the main gaps in the field of study by proposing a quantitative methodology for integrating information based on the knowledge of experts in the decision-making processes select advertising media for online games. Most traditional media selection processes are based solely on experience and estimation, and in practice, they are unable to systematically prioritize the alternatives due to the multiplicity of media available and the complexity of the decision-making process Interval-valued triangular fuzzy numbers (IVTFNs) can address the shortcomings of previous research while considering the uncertainties in this decision-making process. The findings of this framework can be good support for e-commerce managers and online game advertising practitioners.

Introduction

In a world where watching TV is a less prevalent leisure activity, games are rapidly becoming a favoured pastime worldwide (Chaney *et al*., 2018). Hence, the importance of the gaming industry is growing (Chen & Sun, 2014). With the advancement of technology, people spend more time in daily life for entertainment (Gong *et al*., 2020). In recent years, online gaming has become an integral part of users' daily lives and is considered one of the most popular leisure activities (Grimes & Feenberg, 2009). According to the latest research by Newzoo, a market intelligence firm, more than 3 billion users play online around the world, 55% of which are in Asia and the Pacific, which is still the fastest-growing region (Newzoo, 2021). In addition, global gaming revenue is estimated at more than $ 175.8 billion by 2021 and is expected to exceed $ 200 billion by 2023 (Wijman, 2020; Newzoo, 2021).

Due to the widespread popularity of online games in recent years, many games have been released in different genres that compete to gain more market share and attract more audiences. Under such circumstances, online game developers must use effective advertising techniques and tools to attract the users' attention to increase their revenue (Scharrer, 2004). Therefore, paying attention to the patterns and models of effective advertising planning is extremely important in the online gaming industry. Despite this importance, we see less research in advertising media selection that has specifically examined advertising media selection for online games. Most of the previous studies, instead of focusing on how to advertise online games effectively, have dealt with the subject of online in-game advertising and have often considered online gaming as a platform for advertising other products and services (Terlutter & Capella, 2013; Mishra & Malhotra, 2020; Smith *et al*., 2020). However, considering the audiences of online games and their unique features, planning and choosing the right advertising media for this category of products is doubly essential, because if an online game fails to achieve significant success through proper advertising programs, it will cause a double loss to both the game developer and the owners of the products and services advertised through this online game.

The selection of advertising media is one of the main components of the media planning process performed by experts in the advertising industry (Krueger & Soley, 2010). All advertising activities should be based on an appropriate advertising program to ensure the effectiveness and cost-effectiveness of advertising programs. An appropriate advertising plan delivers the right messages to the right audience through suitable media (Javan *et al*., 2018).

Media planning has two important aspects: The first is selecting advertising media, and the second is developing and allocating appropriate advertising budgets (Jha *et al*., 2012). However, little work has been done to identify the appropriate criteria for deciding on the proper media selection (Alavijeh *et al*., 2019), and there is still a need for a systematic framework for evaluating and selecting the appropriate media for the desired application area (Tavana *et al*., 2013; Javan *et al*., 2018).

In this study, based on the identified theoretical gap regarding the criteria for selecting media for online game advertising, the first focus is on the first dimension of media planning, i.e. media selection in online game advertising. In other words, the first purpose of this study is to identify the criteria and factors based on which the usable media are selected for online game advertising, an approach that has unexpectedly received less attention in previous studies in the field of online game advertising.

On the other hand, a review of studies in the field of media planning shows that most of them are based on traditional procedures and rules of thumb instead of using formal and known knowledge, which is the foundation of effective planning (Coulter & Sarkis, 2005; Javan *et al*., 2018). A significant problem with this approach in media selection is that although this choice must rely to some extent on human judgment, its solution is too complex to be achieved merely by human judgment (Javan *et al*., 2018). For this reason, numerous studies have been conducted using quantitative models. These studies show their focus is on the second aspect of media planning (i.e. allocating an appropriate advertising budget). Therefore, most of them focused on applying complex mathematical techniques such as goal, dynamic or linear programming. As a result, in addition to being challenging to implement in the real world, they have many disadvantages, including high cost and time consumption (Tafreshi *et al*., 2016).

Accordingly, the present study considers the shortcomings mentioned above and tries to provide a systematic framework based on MADM methods to evaluate and select the appropriate media in the space of interval-valued fuzzy sets (IVFs).

The article's structure is as follows: the next section presents the theoretical literature; the third section describes the research methodology and techniques; the fourth section presents the research findings. The authors analyzed and discussed the findings and checked their validity in the fifth section. In the final section, the authors provide a summary and recommendations for future research.

Literature review

Online games and the importance of advertising

Gaming is a critical activity in human behavior, and games have existed throughout history (Ramírez-Correa *et al*., 2019). Because a human is a very social being, as he/she grows, he/she becomes more connected to his/her age group, and games become essential for growth and learning (Nanda & Warms, 2010). Therefore, it is not surprising that online games have become part of people's daily lives in recent years (Hamari *et al*., 2015). Studies show that the amount of time people spend on online games is 32% of the total time they spend online (Valaei *et al*., 2019).

The evolution of online gaming is inherently linked to advances in technology and the growth of the Internet. Today, these advances allow players to compete remotely around the world (Aghey, 2020). The emergence of information technology in society and the personal use of smartphones and global communication networks have entered a new phase in the design and development of games (Ramírez-Correa *et al*., 2019). With the myriad of video games now available online, players from all over the world can interact simultaneously (Harris *et al*., 2020). It is why the video game industry has become a multi-billion dollar industry (Shieber, 2019; Shi *et al*., 2020).

Despite the differences in estimates about the exact size of the video game industry, the dimensions of this industry are undoubtedly vast. This industry will generate more than $ 175 billion in revenue in 2021 (Newzoo, 2021). However, the estimates show that online gaming will make significant profits in the future, and with the increasing popularity of broadband Internet access, this market will continue to grow (Merhi, 2016; Ramírez-Correa *et al*., 2019). In particular, an online game, for example, Diablo III, sold more than 3.5 million copies on its opening day (Statista, 2019), demonstrating the enormous potential of popular online games for profit. In the United States, 64% of the general population are online game users, and 27% of them spend more than 10 hours a week on online games (Gong *et al*., 2020).

Games (including computer games, console games, and online games) are here to stay. Although the continued expansion of the video game industry is likely to increase revenue with the participation of more stakeholders, this will not be possible without the use of appropriate advertising tools (Shi *et al*., 2020). Advertising improves awareness and knowledge about games and increases participation (Pitt *et al*., 2017). In addition, due to the ability of advertising to transmit cultural codes in the media, it is an ideal tool for understanding the content of video games and interpreting these games (Chess *et al*., 2016).

Paying attention to effective advertising programs for online games can positively affect the sale and promotion of these products. In addition, an online game can be an appropriate environment for advertising and selling other products and services that use online games to introduce and advertise. Reviewing the available data and evidence shows that the gaming industry has provided significant opportunities for marketing and advertising communications (Chaney *et al*., 2018), and therefore, in recent years, digital games have attracted the attention of executives and decision-makers in the advertising industry (Herrewijn & Poels, 2015; Lewis & Porter, 2010). Recently, with the emergence of new games in different forms and formats, the desire of game companies to attract teenagers and adults has increased, which has led to an increase in the desire for advertising in this area (Labrador *et al*., 2020). However, little attention has been paid to their marketing from a scientific and theoretical point of view; so new research is needed in this field (Consalvo, 2003).

Media planning

Advertising in a medium is effective only if many target customers are exposed to that medium; therefore, media planning is necessary to provide a comprehensive model to maximize access to advertising messages and optimize the use of advertising budgets (Aggarwal *et al*., 2014). Media planning involves a series of decisions designed to evaluate how to provide advertising communications to potential buyers of goods or services (Coulter & Sarkis, 2005). Choosing the media is often challenging because of the economic importance of the decision and the wide range of available alternatives (Coulter & Sarkis, 2006). Moreover, decision-makers should take into account both international and local perspectives (Hashemkhani Zolfani *et al*., 2013). The media planning process has two main steps: selecting advertising media and developing and allocating advertising budget. In the first step, the existing media are evaluated and prioritized, and in the second step, an optimal combination of media is obtained considering the goals of the advertising campaign and budget constraints (Jha *et al*., 2012; Javan *et al*., 2018). There are various media in the market, from TV to websites and how media are combined and used changes over time. In addition, choosing the most appropriate media combination from the available alternatives depends on various factors, including the specific goals of the advertising campaign, customer profile, market situation, and competitive conditions (Aggarwal *et al*., 2014).

In addition, each media has specific advantages and disadvantages in terms of reach, frequency, impact, and cost (Coulter & Sarkis, 2006), which makes the process of deciding on the appropriate media more difficult and emphasizes the need to achieve a structured and efficient framework for optimal media selection. Early media selection models in the 1910s and 1960s were often subjective, judgmental, and qualitative (Javan *et al*., 2018). However, these procedures are disabled to simultaneously consider the numerous factors influencing media decision-making and could not be applied effectively (Coulter & Sarkis, 2005). Hence, the limitations of subjective models of researchers led them to seek better and more systematic methods for media planning after the 1950s by introducing operation research techniques and computer facilities and access to information. So, a new era of media planning models was introduced in the early 1960s (Calantone & Todorovic, 1981; Javan *et al*., 2018).

These models consist of some quantitative and optimization methods and typically use mathematical programming (e.g., linear, dynamic, integer, or nonlinear) to help us choose the media (Coulter & Sarkis, 2006). A review of these articles and models shows that their primary focus has been on allocating appropriate advertising budgets as the second phase of media planning. However, the main problem is identifying the criteria and framework appropriate to the conditions and the subject of advertising, i.e., the advertising media selection as the first phase (Javan *et al*., 2018; Alavijeh *et al*., 2019).

Different parameters affect the choice of appropriate media. Ngai (2003) identified five leading indicators of impression rate, monthly cost, audience fit, content, and look & feel as essential criteria in choosing advertising media. Coutler and Sarkis (2005) focused their research on quality, time, flexibility, coverage, and cost. Krueger and Soley (2010) identified and introduced the following nine indicators for media planning, reach, frequency, impression, CPM, communication goals, frequency of competitors' campaign, brand loyalty, characteristics of the product's target market, and attentiveness. Factors identified by Moorman *et al*. (2010) include cost, time, reach & frequency. Farzipoor Saen (2011) presented four indicators for media selection in cases with inaccurate data and flexible factors: the size of the audience, accuracy of targeting, durability of media, and volume of the supplied information.

Tavana *et al*. (2013) presented effective indicators to provide a model for selecting a social networking platform, including content, impression score, cost, look & feel, and audience fit. Reddick and Anthopoulos (2014) considered four criteria of the digital divide, user satisfaction, nature of interaction and security & privacy, as the most critical factors in choosing advertising media. Ahmady *et al*. (2015) introduced three criteria for advertising media selection: the number of circulations, advertising cost, and reputation. Calli (2016) introduced four indicators of content quality, social gratifications, audience fit and irritation to provide a model for choosing social networks. Tafreshi *et al*. (2016) considered the reach, cost, impression, audience composition, brand penetration, brand awareness, advertising awareness and top of mind as the essential factors to provide a group decision support system for evaluating advertising media. Javan *et al*. (2018) applied attention, interest, desire and action as four criteria based on the AIDA model to provide a hybrid advertising media selection model. Nawi *et al*. (2019) introduced six leading indicators of performance expectancy, perceived trust, facilitating conditions, perceived enjoyment, perceived risk and social influence as critical factors in choosing the appropriate social media. Alavijeh *et al*. (2019) identified frequency, time, attention, and last reminder before purchase, the oldness of the message, cost and visibility as effective indicators in prioritizing environmental advertising media. Sudipa *et al*. (2020) considered a security, application features, community, ease of access, and response speed the main criteria in the media selection process.

A review of the above research shows that researchers still have little agreement on these criteria, and a relatively comprehensive model meeting all the criteria is needed. Besides, these criteria need to be examined and analyzed based on the advertising requirements in the online gaming industry.

On the other hand, a wide range of alternatives available (Coulter & Sarkis, 2006; Farzipoor Saen, 2011; Tafreshi *et al*., 2016), in addition to the numerous criteria, has made the proper advertising medium selection a complex issue with multiple and sometimes conflicting criteria (Farzipoor Saen, 2011). Despite much research in this area, a comprehensive framework is still needed to allow simultaneous attention to these criteria in the selection phase (Javan *et al*., 2018). Due to the capability of MADM methods in the face of such situations, many researchers have considered them in recent years (Heidary Dahooie *et al*., 2019; Heidary Dahooie *et al*., 2021). Some researchers in advertising have also tried to use these methods in choosing advertising media (Ngai, 2003; Coutler & Sarkis, 2005; Tavana *et al*., 2013; Tafreshi *et al*., 2016).

Utilizing these methods has been a valuable support for decision-makers in the media advertising field (Ngai, 2003) by providing the possibility of combining complex issues and different data in order to reach a logical and acceptable answer (Tavana *et al*., 2013). One of the main problems of this category of methods is the lack of sufficient attention to ambiguity and uncertainty in the decision-making process (Dyer *et al*., 1992; Javan *et al*., 2018). This uncertainty is partly due to some qualitative criteria used in the evaluation of advertising media, which has led to the use of linguistic variables. On the other hand, the lack of sufficient information and data to decide on appropriate advertising media has added to this ambiguity (Farzipoor Saen, 2011). Additionally, the complexity and difficulty of evaluating a wide range of media based on different indicators require the specialized opinion of a group of experts in different dimensions (Tafreshi *et al*., 2016). The above reasons increase the need for a framework that allows individuals to make group decisions in media selection based on uncertain data (Tafreshi *et al*., 2016).

Research methods

The purpose of this study is to provide a framework for selecting appropriate advertising media for online games that can help decision-makers in this area for the initial prioritization of appropriate media. In this way, they can then allocate appropriate budgets and plan an advertising campaign, considering organizational constraints. Researchers in this field have adapted MADM methods to consider different and sometimes inconsistent criteria and that different decision-makers with different interests may be involved in the process. On the other hand, due to the uncertainty in this decision, it is necessary to use approaches that recognize uncertainty, which is sometimes rooted in the impact of environmental variables, lack of sufficient information about the criteria and sometimes low level of knowledge of decision-makers (Turskis *et al*., 2013). In addition, the proposed framework should be able to aggregate the opinions of different experts. Due to the ability of interval-valued fuzzy sets in modelling uncertainty problems, in this paper, a new hybrid approach has been used in the field of MADM based on IVFs. The research steps are presented in Figure 1. Next, these steps have been used to select the appropriate media in the company under review.

Figure 1 shows the criteria identified in the first step and based on the main overview for the most critical decisions in the media selection process. Although we did not use the systematic literature review in this study, some general guidelines were considered for the selection of papers as sources for the selection of the criteria according to Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement. Keywords are in the title, the keywords section or the abstract of the and the paper is published in a scientific peer-reviewed journal (Siksnelyte-Butkiene *et al*., 2021, p. 3).

The list was then delivered to six experts in the form of a fuzzy Delphi process. On the one hand, these experts had an academic education in marketing and advertising, and on the other hand, they had worked in the online game industry for at least six years. After careful consideration, they identified and proposed a list of criteria relevant to advertising and marketing in online games. They also identified and suggested media from the existing advertising media set more relevant to the online gaming industry. In the next step, evaluating the desired alternatives based on the identified criteria, the developed SWARA method based on interval-valued triangular fuzzy numbers (IVTFN SWARA) was used to weight the criteria. In addition, the Additive Ratio Assessment method based on IVTFN (IVTFN ARAS) was used to rank the advertising media. Due to the need to pay attention to the opinions of organizational decision-makers in determining the importance of criteria and completing the decision table, it was necessary to have a committee consisting of industry experts and company decision-makers. The head of the company and the board of directors, taking into account the importance of advertising planning at the highest level of the organization, formed a six-member committee responsible for setting the criteria weights and values and finalizing the decision table. Finally, decision-makers calculated the importance of each criterion and the scores of each media, which are an essential contribution to the budget and operational planning in the next phase.

Interval-valued triangular fuzzy numbers (IVTFN)

Zadeh (1965) proposed fuzzy number set theory. A fuzzy number is a convex fuzzy set described by a specific interval of real numbers, and each has a membership value in the range of 0 and 1. One of its applications is in the decision-making process based on vague and ambiguous information such as decision makers' judgments (Dahooie *et al*., 2020). In such cases, linguistic variables often represent evaluations in complex and ill-defined problems. Zadeh (1975) proposed several modifications, such as n-type fuzzy sets, to reflect natural problem conditions and overcome the shortcomings of the fuzzy method.

It should be noted that determining this value precisely is not easy in some cases; so, the membership value can be represented by an interval of real numbers (Ashtiani *et al*., 2009; Vahdani *et al*., 2014). In this regard, Gorzałczany (1987) introduced interval-valued fuzzy sets as a generalized concept of fuzzy numbers. Yao and Lin (2002) presented an interval-valued triangular fuzzy number as:

$$\tilde{A} = \left[\tilde{A}^L, \tilde{A}^U\right] = \left[(a'_l, a'_m, a'_u; \omega'_A), (a_l, a_m, a_u; \omega_A)\right] \tag{1}$$

where $\tilde{A}^L$ and $\tilde{A}^U$ represent lower and upper triangular fuzzy numbers, respectively; $\tilde{A}^L \subset \tilde{A}^U; \mu_{\tilde{A}}(x)$ represents the membership function and the degree to which an event may be a member of $\tilde{A}; \mu_{\tilde{A}^L}(x) = \omega'_A$ and $\mu_{\tilde{A}^U}(x) = \omega_A$ are the lower and upper membership functions, respectively.

If $\omega'_A = \omega_A = 1$, then triangular fuzzy numbers are obtained by normalized interval-valued triangular fuzzy numbers (Stanujkic, 2016):

$$\tilde{A} = \left[\tilde{A}^L, \tilde{A}^U\right] = \left[(a_l, a'_l), a_m, (a'_u, a_u)\right] \tag{2}$$

For more details about algebraic operations read Stanujkic (2016).

SWARA method based on interval-valued triangular fuzzy numbers

Different multi-criteria decision-making methods need criteria weights. Criteria weights could be crisp or vague determined. Decision-makers could use different methods to determine criteria importance (weights) (Turskis *et al.,* 2019; Baradari *et al.,* 2021; Keshavarz-Ghorabaee *et al.*, 2021), as well as to aggregate weighted criteria values (Turskis *et al*., 2012; Zavadskas *et al*., 2017). Keršulienė *et al*. (2010) presented the Step-wise Weight Assessment Ratio Analysis (SWARA) method to subjectively weigh the criteria based on the opinions and judgments of decision-makers and experts (Ruzgys *et al*., 2014; Karabasevic *et al*., 2016). Due to its low complexity and little time consumed, this method is one of the subjective methods. The main feature of this method is the ability to estimate the opinions of experts or stakeholder groups about the importance of criteria in the weighting process (Mardani *et al*., 2017). The steps of the SWARA-IVTFN method are described below:

1. Criteria Prioritization: At this stage, the final criteria for evaluating the alternatives based on importance are arranged in descending order by each decision-maker.
2. Determining the relative importance for the criteria ($\tilde{S}_j$): The relative importance of each criterion is measured relative to the criterion with a higher rank; $\tilde{S}_j$ denotes the corresponding value.
3. Calculating the coefficient $\widetilde{K}_j$: As a function of relative importance for each criterion, this coefficient is determined using the following Eq.:

$$\tilde{k}_j = \begin{cases} \tilde{1}, j = 1 \\ \tilde{s}_j + \tilde{1}, j > 1 \end{cases} \tag{3}$$

4. Calculating the initial weight for the criteria ($\tilde{q}_j$): In this step, the initial weight of each criterion is obtained using Eq. (4).

$$\tilde{q}_j = \begin{cases} \tilde{1}, j = 1 \\ \dfrac{\tilde{q}_{j-1}}{\widetilde{K}_j}, j > 1 \end{cases} \tag{4}$$

5. Calculating the final normalized weights ($\widetilde{w}_j$): Finally, Eq. (5) helps decision-makers to obtain the final normalized:

$$\widetilde{w}_j = \frac{\tilde{q}_j}{\sum_{k=1}^{n} \tilde{q}_k} \tag{5}$$

In addition, in order to represent the final weights of the criteria, the defuzzification process has been used as Eq. (6):

$$gm(\tilde{B}) = \frac{l + l' + m + u' + u}{5} \quad (6)$$

Additive ratio assessment (ARAS) method based on interval-valued triangular fuzzy numbers

Different MADM methods helped decision-makers to solve complicated economic problems (Zemlickienė *et al.*, 2018; Zolfani *et al.,* 2021; Skvarciany *et al.,* 2021). In 2010, Zavadskas and Turskis introduced the ARAS method as one of the practical and novel methods in the field of MADM (Zavadskas & Turskis, 2010; Turskis, & Zavadskas, 2010a; Turskis, & Zavadskas, 2010b). The steps of the ARAS-IVTFN method are described below (Dahooie *et al*., 2018):

1. Forming a decision matrix and determining the optimal performance rating for each criterion:

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{01} & \cdots & \tilde{x}_{0j} & \cdots & \tilde{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \tilde{x}_{i1} & \cdots & \tilde{x}_{ij} & \cdots & \tilde{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \tilde{x}_{m1} & \cdots & \tilde{x}_{mj} & \cdots & \tilde{x}_{mn} \end{bmatrix}; i = 0,1, \dots, m; j = 1, 2, \dots, n \quad (7)$$

There m is the number of alternatives; n is the number of criteria describing each alternative; $\tilde{x}_{ij}$ is the interval-valued fuzzy number expressing the performance value of alternative i in terms of j criterion; $\tilde{x}_{0j}$ is the optimal value of the j criterion. The symbol '~' above each letter represents an interval-valued fuzzy set.

The optimal performance rating for each interval-valued criterion is calculated through Eq. (8):

$$\tilde{x}_{0j} = \left[\left(l_{0j}, l'_{0j}\right), m_{0j}, \left(u'_{0j}, u_{0j}\right)\right] \quad (8)$$

Other symbols are defined as follows:

$$l_{0j} = \begin{cases} \max\limits_i l_{ij}; j \in \Omega_{max} \\ \min\limits_i l_{ij}; j \in \Omega_{min} \end{cases} \quad l'_{0j} = \begin{cases} \max\limits_i l'_{ij}; j \in \Omega_{max} \\ \min\limits_i l'_{ij}; j \in \Omega_{min} \end{cases} \quad u_{0j} = \begin{cases} \max\limits_i u_{ij}; j \in \Omega_{max} \\ \min\limits_i u_{ij}; j \in \Omega_{min} \end{cases} \quad (9)$$

$$m_{0j} = \begin{cases} \max_i m_{ij}; j \in \Omega_{max} \\ \min_i m_{ij}; j \in \Omega_{min} \end{cases} \qquad u'_{0j} = \begin{cases} \max_i u'_{ij}; j \in \Omega_{max} \\ \min_i u'_{ij}; j \in \Omega_{min} \end{cases}$$

In these equations, Ω_{max} denotes the benefit-type criteria (where the higher value is preferable), and Ω_{min} stands for cost value criterion: the less, the (Zavadskas *et al*., 2021)

2. Calculating the normalized decision matrix: Decision-maker can use Eq. (10) for normalization:

$$\tilde{\bar{X}} = \begin{bmatrix} \tilde{\bar{x}}_{01} & \cdots & \tilde{\bar{x}}_{0j} & \cdots & \tilde{\bar{x}}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \tilde{\bar{x}}_{i1} & \cdots & \tilde{\bar{x}}_{ij} & \cdots & \tilde{\bar{x}}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \tilde{\bar{x}}_{m1} & \cdots & \tilde{\bar{x}}_{mj} & \cdots & \tilde{\bar{x}}_{mn} \end{bmatrix}; i = 0,1, \dots, m; j = 1, 2, \dots, n \tag{10}$$

$$\tilde{\bar{x}}_{ij} = \begin{cases} \left[\left(\frac{a_{ij}}{c_j^+}, \frac{a'_{ij}}{c_j^+}\right), \frac{b_{ij}}{c_j^+}, \left(\frac{c'_{ij}}{c_j^+}, \frac{c_{ij}}{c_j^+}\right)\right]; j \in \Omega_{max} \\ \left[\left(\frac{\frac{1}{a_{ij}}}{a_j^-}, \frac{\frac{1}{a'_{ij}}}{a_j^-}\right), \frac{\frac{1}{b_{ij}}}{a_j^-}, \left(\frac{\frac{1}{c'_{ij}}}{a_j^-}, \frac{\frac{1}{c_{ij}}}{a_j^-}\right)\right]; j \in \Omega_{min} \end{cases} \tag{11}$$

There $\tilde{\bar{x}}_{ij}$ represents the interval-valued fuzzy optimal performance rating for the i-th alternative based on the j-th criterion. Furthermore:

$$a_j^- = \sum_{i=0}^{m} \frac{1}{a_{ij}}, c_j^+ = \sum_{i=0}^{m} c_{ij}, i = 0, 1, \dots, m \tag{12}$$

3. Calculating the weighted normalized interval-valued decision matrix: In this step, the weighted normalized matrix $\tilde{\hat{X}}$ is defined through the normalized weight of the final criteria using the developed SWARA method based on interval-valued triangular fuzzy numbers and the normalized decision matrix.

$$\tilde{\hat{X}} = \begin{bmatrix} \tilde{\hat{x}}_{01} & \cdots & \tilde{\hat{x}}_{0j} & \cdots & \tilde{\hat{x}}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \tilde{\hat{x}}_{i1} & \cdots & \tilde{\hat{x}}_{ij} & \cdots & \tilde{\hat{x}}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \tilde{\hat{x}}_{m1} & \cdots & \tilde{\hat{x}}_{mj} & \cdots & \tilde{\hat{x}}_{mn} \end{bmatrix}; i = 0,1, \dots, m; j = 1, 2, \dots, n \tag{13}$$

The weighted normalized values of all criteria are obtained through the following equation:

$$\tilde{\hat{x}}_{ij} = \widetilde{w}_j . \tilde{x}_{ij};\ i = 0,1, \dots, m \tag{14}$$

4. Calculating the overall performance index for each alternative using Equation (15):

$$\tilde{S}_i = \sum_{j=1}^{n} \tilde{\hat{x}}_{ij}\ ;\ i = 0,1, \dots, m \tag{15}$$

There $\tilde{S}_i$ represents the overall interval-valued performance rating for the i-th alternative.

5. Calculating the utility degree for each alternative: The result of fuzzy decision making for each alternative is in the form of interval-valued fuzzy numbers ($\tilde{S}_i$). The defuzzification process is performed in different ways, which may affect the results. Using Eq. (16), the defuzzification process is performed for $\tilde{S}_i$:

$$S_i = \frac{(1-\lambda)S_{il} + \lambda S_{il'} + S_{im} + \lambda S_{iu'} + (1-\lambda)S_{iu}}{5}\ , \lambda \in [0,1] \tag{16}$$

There λ is a coefficient between 0 and 1. Changing this coefficient, we can give more importance to the parameters $S_{il'}$ and $S_{iu'}$ than the parameters S_{il} and S_{iu}, respectively (and vice versa).

6. The utility degree of each alternative is obtained by comparing it with the ideal value of S_0. The utility degree of alternative A_i is determined through Eq. (17):

$$K_i = \frac{S_i}{S_0};\ i = 0,1, \dots, m \tag{17}$$

There S_0 and S_i are defuzzified values of the optimal index obtained from Eq. (16). K_i is also a value in the range of [0, 1]. Finally, the decision-makers ranked the alternatives based on K_i values.

Case study and results

The case study is an online game developer company in Turkey, seeking to enter the market of Iran, one of the largest Middle Eastern countries, and intended to design extensive advertising campaigns using advertising channels in Iran. According to Newzoo's report, the overall revenue of video games in the Middle East in 2018 was $4.9 billion (Newzoo, 2018). Based on the findings of a native report from March 2017 to February 2018, Iran, with an estimated population of 81 million, had 28 million gamers and has a high potential to increase in the coming years (Khoshsaligheh & Ameri, 2020; Iran Computer and Video Games Foundation, 2018). Iran is not among the top countries in terms of game production revenue. Newzoo (2019) ranked it as 23rd with sales of $ 602 million in 2018. The overall income of the "digital gaming market" in Iran is $ 269 million, which includes the cost of purchasing game hardware (Iran Computer and Video Games Foundation, 2018). In general, all this information reflects the popularity of video games in Iranian society, and this market can potentially become a thriving one for domestic and foreign video games (Khoshsaligheh & Ameri, 2020).

In the case study of this research, since the managers of this international company intend to develop their market in Iran, it is necessary to obtain a detailed advertising program that can meet their goals. Entering international markets and maintaining the position in the current market is the motivation of the game developers of this company to introduce their products to other countries. Therefore, the investors of this company became interested in the rapid development and undiscovered potentials of this industry in Iran and decided to achieve localized advertising planning in Iran through a well-structured and targeted study. A six-member committee consisting of the company's research and development managers and the companies responsible for developing, publishing and advertising games in Iran was formed to present this plan. This committee identified and introduced effective criteria set in media decision-making and criteria weighting and completing the decision table. The following are the findings of various steps of our methodology.

Criteria identification

As mentioned earlier, one of the most important objectives of this research is to provide a decision model to select the appropriate advertising media in online games. Based on the background review, Table 1 shows a list of identified criteria used in the literature.

Then, according to the requirements of the product (online games), the list of identified criteria in the form of the fuzzy Delphi questionnaire was provided to experts in the field of marketing and advertising in the online gaming industry in order to localize the criteria for selecting the appropriate advertising media. The questionnaire consisted of two parts. The first part was considered for assessing the appropriateness of the criteria extracted from the literature with the field of research (selection of appropriate media in the online gaming industry). In the second part, they were asked to suggest other criteria that can be effective in the evaluation. Figure 2 presents the final list of criteria and decision models after obtaining experts' opinions.

The expert group received a list of all available media and advertising channels, based on an assessment of the research team's experience and background, to list alternatives at the last level of this model. This list included those commonly used by advertisers and advertising agencies, including online and offline media. After reviewing the available alternatives, ten media were identified and presented by experts that were most relevant to the online gaming space and are more considered by the developers of these games in Iran.

Calculation of criteria weight based on IVTFN SWARA

In this section, the developed IVTFN SWARA was used to determine the weight of the main criteria and related sub-criteria based on the opinions of committee members. For this purpose, the linguistic variables proposed by Stanujkic *et al*. (2015) have been used (Table 2).

Table 3 presents the results of the first expert obtained according to the developed extension IVTFN SWARA method. Later, decision-makers use normalized expert team members' opinions about criteria importance geometric mean values to establish the final weights of the criteria for the considered problem. Table 4 shows the results.

IVTFN ARAS results

After calculating the final criteria and sub-criteria weights, the committee members evaluated each of the identified media based on these criteria and in terms of the linguistic variables presented in Table 5.

As mentioned earlier, the list of advertising media was identified in two main categories, including offline media and online media. After obtaining the opinions of the field experts and committee members, they were finalized in the form of ten media suitable for marketing and advertising in the field of online games. Table 6 represents the final list of media and evaluation of each from the point of view of decision-makers.

Later, decision-makers the linguistic variables replaced by the corresponding interval-valued triangular fuzzy numbers. Then, they averaged experts' opinions to aggregate them and formed a group decision table. After forming the aggregated decision matrix, it was normalized based on Eq. (11), and then the weighted normalized decision matrix was calculated based on Eq. (14) using the weights calculated in the previous step (Table 7).

Finally, the overall performance index for each alternative ($\tilde{S}_i$) was calculated based on Equation 15 (second column of Table 8). The columns (K_i) in Table (8) represent the utility degree calculated for each alternative obtained from Eq. (17). The results of the evaluation are used as input to the next stage in the evaluation framework development.

Discussion

According to research findings, in setting priorities to the main criteria for implementing the three possible scenarios, the audience relevancy ratio has the highest weight and is therefore first. Since media planning aims to convey the right message through the media appropriate to the audience of that particular product (Javan *et al*., 2018), it is not far-fetched to place the criterion of audience fit in the priority. Also, prioritizing the sub-criteria of this criterion shows that among all the factors representing the audience fit, the sub-criterion of product fit is the most important one, because the effectiveness of an advertisement is inextricably linked with the relevance of the media used and the product being advertised (Till & Busler, 2000; Schouten *et al*., 2020). The next position belongs to the convenience of a media, and the media that provides easier access for users is given a higher priority in the media selection process. User-friendliness is a sub-criterion which is the next priority and which is related to design innovation that makes the user easily communicate with the intended media (Ngai, 2003). The next priority is assigned to the extent of the user's interaction with the media. This sub-criterion indicates the extent to which the customer can respond to the information conveyed by the ads in a particular medium (Coulter & Sarkis, 2006). The degree of flexibility of the media in terms of time, age, gender, and others, and finally, the media facilitating conditions are the following priorities.

Based on the findings of this study, the criterion of attractiveness is at the second place in terms of importance in media selection. Since marketers and advertisers have found that games represent unique opportunities to reach a diverse audience through a fun and engaging medium (Cicchirillo, 2019), they emphasize this indicator in their media planning. In addition, the essential sub-criterion identified in media attractiveness is the impression that the media perceives, and then the media's attentiveness is in the second place. E. St. Elmo Lewis theorized that for an advertising campaign to be successful, it must first stimulate the audience's interest and emotion and draw their attention (Javan *et al*., 2018). In addition, research in the field of in-game advertising has shown that a person's emotional experiences have a significant impact on ad processing (Grigorovici & Constantin, 2004; Jeong & Biocca, 2012; Herrewijn & Poels, 2015). Media credibility as the next priority is another sub-criterion for the attractiveness component. According to Zha *et al*. (2015), it plays a vital role in determining the effectiveness and value of advertising (Zha *et al*., 2015; Sari *et al*., 2020). The reputation and popularity of the media is another sub-criterion of this dimension. At the end of this list are the sub-criterion of informativeness and access to information through the media. According to Sari *et al*. (2020), most millennials are transitioning from traditional media to online to get the latest information. Since the primary audience for online games is young people, it can be expected that media informativeness would be of some interest to the audience of this type of game.

The findings of this study showed that in the field of potential risks in media selection, infrastructure constraints could be considered the most critical deterrent to media selection. Given that various infrastructures, including the Internet and technology, are recognized as a critical concept in media and communication studies in the age of globalization and digitalization (Plantin & Punathambekar, 2019), the restrictions and related barriers can have a significant impact on media choice. The next most significant factor is the risk of fraud in the media and advertising industry as a severe problem for many activists in this field (Dörnyei, 2020). Fraud has long been one of the biggest problems on the Internet (Wilbur & Zhu, 2009), and online advertising is increasingly one of its primary victims and the bedrock of all kinds of advertising fraud, such as fake clicks, unrealistic installation or downloads, traffic generated by robots, and others (Dörnyei, 2020). Laws restricting media content and regional legal barriers are other factors to consider in the area of media choice risk. Content restrictions refer to the rules set by the media to prevent the display of specific infringing content. Violent and racist content is among the content that may be banned. The legal barriers of each region also depend on the policies of that region. The risk of the presence of competitors is another factor that affects the visibility and effectiveness of advertising and prevents the success of an advertising campaign.

This process presented the prioritization of the media in the form of three scenarios. Since online games are played on the Internet, it was expected that online media would be the most important in choosing an advertising program. It is what happened, and almost all online media have a higher priority than others do. Online advertising has significant advantages over other media regarding high audience reach, impact, cost, flexibility, and short lead-time (Kassaye & Wossen, 1999; Coulter & Sarkis, 2005). Table 8 shows the results obtained in the media prioritization phase.

In recent years, the number of online users who reach their desired result through search engines instead of going directly to a website has been increasing at a tremendous rate (Aashirwad Kumar, 2020). It has made the search engine the most critical medium for advertising and especially online product promotion. The results also confirmed this and introduced search engine advertising as the most critical media for online game advertising. Social networks are the next priority. According to the audience of online games, which is primarily young people, this media is a perfect space to attract the audience. In addition, the low cost of advertising on social networks has made it a suitable platform for advertising or attracting users (Paulson *et al*., 2018). In addition, the availability of most social media allows for various social interactions such as viral social activity and community engagement (Tavana *et al*., 2013; Li & Shiu, 2012).

On the other hand, other results indicate that environmental advertising and newspaper and magazine ads have the least weight and priority in the advertising program for online games. In addition to being old and traditional, these media have targeted a smaller audience in our area. It has led online game advertising planners to show less interest in these platforms as suitable advertising mediums (Wang & Sparks, 2019).

Theoretical and methodological contribution

The decision to choose the media is often challenging, not only because of the economic importance of the decision; but also because of the wide range of available alternatives. As mentioned, most studies in the field of media planning are based on traditional practices. In addition, the few studies conducted with quantitative approaches have shortcomings in dealing with real-world conditions. On the other hand, choosing a suitable advertising medium is a complex problem with multiple and sometimes contradicting criteria. Accordingly, researchers gradually considered MADM methods for modelling and selecting the appropriate advertising media. MADM methods provide valuable support for decision-makers in the field of advertising media. The purpose of MADM methods is not to provide an optimal solution. As a decision support tool, these methods make it possible to aggregate complex topics and problem data to find a logical and acceptable answer. The critical point in the decision-making process is that the criteria used to evaluate the advertising media are sometimes qualitative, and decision-makers cannot assess them using quantitative numbers. As a result, the data will be ambiguous and imprecise.

The wide range of advertising media, the lack of knowledge and competence of planners in all aspects of the issue and the lack of access to relevant information for assessment increase uncertainty. These factors have increased the need for frameworks that allow group decision-making in media selection based on uncertain data. However, many previous studies have not taken into account qualitative data such as expert opinions and knowledge. Accordingly, a hybrid framework was proposed in this article to provide a suitable and optimal solution for prioritizing existing media and media planning in the online gaming industry. On the one hand, the proposed framework is based on criteria appropriate to the conditions and features of online games. On the other hand, it has tried to cover the shortcomings of previous approaches in the face of inherent uncertainty by using MADM methods developed in the space of interval-valued fuzzy sets.

This paper addresses one of the main gaps in the field of study by proposing a quantitative methodology for integrating information based on the knowledge of experts in the decision-making processes select advertising media for online games. Most traditional media selection processes are based solely on experience and estimation, and in practice, they are unable to systematically prioritize the alternatives due to the multiplicity of media available and the complexity of the decision-making process. Hence, our methodology provides an answer to this complexity. This study has structured the media selection decision-making process by considering advertising experts' experience, expertise, and judgment, especially in the online gaming industry, to reflect what is happening in the real world.

Practical implications

The findings of this study can have different executive contributions. First, it is essential for online game advertising practitioners and policy-makers. In the multi-billion-dollar and popular online gaming industry, proper and optimal advertising is a vital element. As a result, understanding how and why media choices are made plays a significant role for those involved in online game advertising planning. Awareness of the criteria affecting the selection of online game advertising media and having a systematic framework for applying these criteria in advertising media selection decisions play a significant role in practical decisions. Due to the highly competitive online games market in e-commerce, e-commerce managers should use all available tools to design online games and introduce them effectively to consumers of these games. In addition, the use of such tools significantly reduces the risk of wrong decisions that have significant negative consequences, such as wasting huge advertising costs and damaging the online gaming brand. In addition, the effects of the success or failure of online games should not be analyzed only in the online game market. Given the role that online games play as an advertising platform for advertising other products and services, the success of an online game will be twofold for e-commerce managers.

Second, the results of such research can also have some benefits for online gaming consumers. Applying effective criteria for choosing online gaming advertising media can provide better awareness and access for online gaming audiences. Accordingly, online gaming enthusiasts will have better access to their favorite online games through carefully selected media and accessible to them according to their characteristics. Hence, their satisfaction will ultimately increase.

Third, the findings of this study and the methodology introduced for the selection of advertising media can have many applications for other researchers. The approach used in this research to identify and select online game advertising media can be used as an example available to other marketing and advertising researchers of various other products and services to design models tailored to those products and services.

Conclusions

The process of planning and selecting advertising media is done in two stages. The first stage prioritizes all media available to the organization and identify the top media. The second stage presents a suitable combination of the extracted top media based on the budget defined for the campaign and advertising goals. Since most articles in media planning have dealt with the second step of this process, namely advertising budgeting, the focus of the present study was to provide a method for selecting and prioritizing the media in which the available media of the organization are prioritized. The top media from the point of view of experts are identified using a MADM process. Experts performed the prioritization process based on three criteria of media attractiveness, its relevance to the audience, and the possible risks arising from the use of each media. These three criteria and their related sub-criteria were identified in the first stage by reviewing the background of decision-making criteria in media selection by online game advertising experts in the form of the fuzzy Delphi process. These experts were also asked to identify and suggest media from the existing advertising media set that are more relevant to the online gaming industry. Then, the identified criteria and each sub-criterion were weighted and prioritized using linguistic variables using the SWARA-IVTFN extended method, and the importance of each was determined. Research findings show that audience fit should be considered one of the most important factors influencing the choice of online gaming advertising media. In addition, the ranking results using ARAS-IVTFN show that among the various media used to advertise online games, online media have attracted more audience attention due to their greater relevance to online gamers.

Limitations and directions for future research

This research, like other researches, has faced some limitations that should be considered when interpreting the results and can be a basis for future research. As previously mentioned, advertising planning has two main phases, and the current research more focuses on the first phase (media selection). It is, therefore, necessary to determine the optimal composition of the media in the second stage, taking into account the goals and limitations of the advertising campaign. Combining the findings of this study with linear programming in the IVTFN space could be a good topic for future research. However, two well-known methods were used in this study, due to some difficulties during the implementation of these methods, much simpler methods like PIPRECIA and ARCAS have been presented that can be used in future researches. On the other hand, hesitancy in evaluation is one of the essential issues that decision-makers experience in selecting the appropriate advertising medium (whether relative importance scores in calculating the weight of criteria or evaluation of the alternatives). As a suggestion, it is possible to develop appropriate frameworks using Z numbers or HFLTs.

References

Aashirwad Kumar, G. (2020). An analytical study of search engine optimization (SEO) techniques: to maximize number of travelers on an e-content material website. *International Journal of Management (IJM)*, *11*(1), 114–119. doi: 10.34218/IJM.11.1.2020.012.

Aggarwal, S., Kaul, A., Gupta, A., & Jha, P. C. (2014). Multi period advertising media selection in a segmented market. In *Proceedings of the third international conference on soft computing for problem solving* . New Delhi: Springer, 905–928. doi: 10.1007/978-81-322-1768-8_76.

Aghey, C. (2020). Integration of eSports in the structure of Ifs: disruption or continuity? *International Sports Law Journal*, *20*(3), 120–125. doi: 10.1007/s40318-020-00175-7.

Ahmady, N., Saen, R. F., Ahmady, E., & Sadeghi, A. H. (2015). Developing a fuzzy enhanced Russell measure for media selection. *International Journal of Business Innovation and Research*, *9*(4), 470–485. doi: 10.1504/IJBIR.2015.07 0179.

Alavijeh, M. R. K., Foroozan, A., & Afrashteh, A. A. (2019). Identification and prioritisation of effective criteria in the selection of outdoor advertising using the AHP technique. *International Journal of Internet Marketing and Advertising*, *13*(4), 359–373. doi: 10.1504/IJIMA.2019.103464.

Ashtiani, B., Haghighirad, F., Makui, A., & Ali Montazer, G. (2009). Extension of fuzzy TOPSIS method based on interval-valued fuzzy sets. *Applied Soft Computing*, *9*(2), 457–461. doi: 10.1016/j.asoc.2008.05.005.

Baradari, I., Shoar, M., Nezafati, N., & Motadel, M. (2021). A new approach for KPI ranking and selection in ITIL processes: using simultaneous evaluation of criteria and alternatives (SECA). *Journal of Industrial Engineering and Management Studies*, *8*(1), 152–179.doi: 10.22116/JIEMS.2020.228519.1356.

Calantone, R. J., & de Brentani-Todorovic, U. (1981). The maturation of the science of media selection. *Journal of the Academy of Marketing Science*, *9*(4), 490–524.

Calli, L. (2016). Selection of social media sites for advertising: literature review and a model proposal. In *Proceedings of MAC-MME 2016*. Prague: MAC Prague consulting Ltd, 253–261.

Chaney, I., Hosany, S., Wu, M. S. S., Chen, C. H. S., & Nguyen, B. (2018). Size does matter: effects of in-game advertising stimuli on brand recall and brand recognition. *Computers in Human Behavior*, *86*, 311–318. doi: 10.1016/j.chb.2 018.05.007.

Chen, H. J., & Sun, T. H. (2014). Clarifying the impact of product scarcity and perceived uniqueness in buyers' purchase behavior of games of limited-amount version. *Asia Pacific Journal of Marketing and Logistics, 26*(2), 232–249. doi: 10.1108/APJML-07-2013-0084.

Chess, S., Evans, N. J., & Baines, J. J. (2016). What does a gamer look like? Video games, advertising, and diversity. *Television & New Media, 18*(1), 37–57. doi: 10.1177/1527476416643765.

Cicchirillo, V. J. (2019). Digital game advertising (IGA and advergames): not all fun and games. *Journal of Interactive Advertising, 19*(3), 202–203. doi: 10.1080/15252019.2019.1697126.

Consalvo, M. (2003). Zelda 64 and video game fans: a walkthrough of games, intertextuality, and narrative. *Television & New Media*, *4*(3), 321–334. doi: 10.1177/1527476403253993.

Coulter, K., & Sarkis, J. (2005). Development of a media selection model using the Analytic Network Process. *International Journal of Advertising*, *24*(2), 193–215. doi: 10.1080/02650487.2005.11072914.

Coulter, K., & Sarkis, J. (2006). An application of the Analytic Network Process to the advertising media budget allocation decision. *International Journal on Media Management*, *8*(4), 164–172. doi: 10.1207/s14241250ijmm0804_2.

Dahooie, J. H., Meidute-Kavaliauskiene, I., Vanaki, A. S., Podviezko, A., & Abadi, E. B. J. (2020). Development of a firm export performance measurement model using a hybrid multi-attribute decision-making method. *Management Decision, 58*(11), 2349–2385. doi: 10.1108/MD-09-2019-1156.

Dahooie, J. H., Zavadskas, E. K., Abolhasani, M., Vanaki, A., & Turskis, Z. (2018). A novel approach for evaluation of projects using an interval–valued fuzzy additive ratio assessment (ARAS) method: a case study of oil and gas well drilling projects. *Symmetry*, *10*(2), 45. doi: 10.3390/sym10020045.

Dörnyei, K. R. (2020). Marketing professionals' views on online advertising fraud. *Journal of Current Issues & Research in Advertising*, *43*(3), 1–19. doi: 10.1080/10641734.2020.1737276.

Dyer, R. F., Forman, E. H., & Mustafa, M. A. (1992). Decision support for media selection using the Analytic Hierarchy Process. *Journal of Advertising*, *21*(1), 59–72. doi: 10.1080/00913367.1992.10673360.

Farzipoor Saen, R. (2011). Media selection in the presence of flexible factors and imprecise data. *Journal of the Operational Research Society*, *62*(9), 1695–1703. doi: 10.1057/jors.2010.115.

Gong, X., Chen, C., & Lee, M. K. (2020). What drives problematic online gaming? The role of IT identity, maladaptive cognitions, and maladaptive emotions. *Computers in Human Behavior, 110*, 106386. doi: 10.1016/j.chb.2020.106386.

Gorzałczany, M. B. (1987). A method of inference in approximate reasoning based on interval-valued fuzzy sets. *Fuzzy Sets and Systems*, *21*(1), 1–17. doi: 10.1016/0165-0114(87)90148-5.

Grigorovici, D. M., & Constantin, C. D. (2004). Experiencing interactive advertising beyond rich media: impacts of Ad type and presence on brand effectiveness in 3D gaming immersive virtual environments. *Journal of Interactive Advertising, 5*(1), 22–36. doi: 10.1080/15252019.2004.10722091.

Grimes, S. M., & Feenberg, A. (2009). Rationalizing play: a critical theory of digital gaming. *Information Society*, *25*(2), 105–118. doi: 10.1080/01972240802701643.

Hamari, J., Keronen, L., & Alha, K. (2015). Why do people play games? A review of studies on adoption and use. In *Proceedings of the 48th annual Hawaii international conference on system sciences (HICSS), Hawaii, USA, January 5-8, 2015*. IEEE, 3559–3568. doi: 10.1109/HICSS.2015.428.

Harris, N., Hollett, K. B., & Remedios, J. (2020). Facets of competitiveness as predictors of problem video gaming among players of massively multiplayer online first-person shooter games. *Current Psychology*. Advance online publication. doi: 10.1007/s12144-020-00886-y.

Hashemkhani Zolfani, S., Zavadskas, E. K., & Turskis, Z. (2013). Design of products with both international and local perspectives based on Yin-Yang balance theory and SWARA method. *Economic Research-Ekonomska Istraživanja, 26*(2), 153–166. doi: 10.1080/1331677X.2013.11517613.

Heidary Dahooie, J., Estiri, M., Zavadskas, E. K., & Xu, Z. (2021). A novel hybrid Fuzzy DEA-Fuzzy ARAS method for prioritizing high-performance innovation-oriented human resource practices in high tech SME's. *International Journal of Fuzzy Systems*. Advance online publication. doi: 10.1007/s40815-021-01162-2.

Heidary Dahooie, J., Zavadskas, E. K., Vanaki, A. S., Firoozfar, H. R., Lari, M., & Turskis, Z. (2019). A new evaluation model for corporate financial performance using integrated CCSD and FCM-ARAS approach. *Economic Research-Ekonomska Istraživanja*, *32*(1), 1088–1113. doi: 10.1080/1331677X.2019.1613250.

Herrewijn, L., & Poels, K. (2015). The impact of social setting on the recall and recognition of in-game advertising. *Computers in Human Behavior*, *53*, 544–555. doi: 10.1016/j.chb.2014.06.012.

Iran Computer and Video Games Foundation (2018). *Landscape report 2017: the most significant information of digital games consumption in Iran*. Retrieved from http://direc.ir/wp-content/uploads/2018/07/ EnglishLandscape.2017.pdf.

Javan, H. T., Khanlari, A., Motamedi, O., & Mokhtari, H. (2018). A hybrid advertising media selection model using AHP and fuzzy-based GA decision making. *Neural Computing and Applications*, *29*(4), 1153–1167. doi: 10.1007/s00521-016-2517-z.

Jeong, E. J., & Biocca, F. A. (2012). Are there optimal levels of arousal to memory? Effects of arousal, centrality and familiarity on brand memory in video games. *Computers in Human Behavior*, *28*(2), 285–291. doi: 10.1016/j.chb.2011.09.011.

Jha, P. C., Aggarwal, R., Gupta, A., & Aggarwal, S. (2012). An optimal advertising media selection model for promotion of multiproducts in segmented market. *Journal of Statistics and Management Systems*, *15*(1), 61–80. doi: 10.1080/09720510.2012.10701613.

Karabasevic, D., Zavadskas, E. K., Turskis, Z., & Stanujkic, D. (2016). The framework for the selection of personnel based on the SWARA and ARAS methods under uncertainties. *Informatica, 27*(1), 49–65. doi: 10.15388/Informatica.2016.76.

Kassaye, W. W. (1999). Sorting out the practical concerns in World Wide Web advertising. *International Journal of Advertising, 18*(3), 339–361. doi: 10.1080 /02650487.1999.11104765.

Keršulienė, V., Zavadskas, E. K., & Turskis, Z. (2010). Selection of rational dispute resolution method by applying new Step-wise Weight Assessment Ratio Analysis (SWARA). *Journal of Business Economics and Management*, *11*(2), 243–258. doi: 10.3846/jbem.2010.12.

Keshavarz-Ghorabaee, M., Amiri, M., Zavadskas, E. K., Turskis, Z., & Antucheviciene, J. (2021). Determination of objective weights using a new method based on the removal effects of criteria (MEREC). *Symmetry*, *13*(4), 525. doi: 10.3390/sym13040525.

Khoshsaligheh, M., & Ameri, S. (2020). Video game localisation in Iran: a survey of users' profile, gaming habits and preferences. *Translator, 26*(2), 190–208. doi: 10.1080/13556509.2020.1724046.

Krueger, K., & Soley, L. (2010). Advertising media selection. In *Wiley international encyclopedia of marketing*. *Part 4. Advertising and integrated communication*. John Wiley & Sons Ltd. doi: 10.1002/9781444316568.wiem04010.

Labrador, F. J., Bernaldo-de-Quirós, M., Sánchez-Iglesias, I., Labrador, M., Vallejo-Achón, M., Fernández-Arias, I., & Estupiñá, F. J. (2020). Advertising games of chance in adolescents and young adults in Spain. *Journal of Gambling Studies, 37*(3), 1–14. doi: 10.1007/s10899-020-09988-5.

Lewis, B., & Porter, L. (2010). In-game advertising effects: examining player perceptions of advertising schema congruity in a massively multiplayer online role-playing game. *Journal of Interactive Advertising*, *10*(2), 46–60. doi: 10.10 80/15252019.2010.10722169.

Li, Y. M., & Shiu, Y. L. (2012). A diffusion mechanism for social advertising over microblogs. *Decision Support Systems*, *54*(1), 9–22.

Mardani, A., Nilashi, M., Zakuan, N., Loganathan, N., Soheilirad, S., Saman, M. Z. M., & Ibrahim, O. (2017). A systematic review and meta-analysis of SWARA and WASPAS methods: theory and applications with recent fuzzy developments. *Applied Soft Computing*, *57*, 265–292. doi: 10.1016/j.asoc.2017.03.045.

Merhi, M. I. (2016). Towards a framework for online game adoption. *Computers in Human Behavior*, *60*, 253–263. doi: 10.1016/j.chb.2016.02.072.

Mishra, S., & Malhotra, G. (2020). The gamification of in-game advertising: examining the role of psychological ownership and advertisement intrusiveness. *International Journal of Information Management, 61*, 102245. doi: 10.1016/j.ijinfomgt.2020.102245.

Moorman, M., Neijens, P. C., & Smit, E. G. (2010). Advertising media selection and planning. In *Wiley international encyclopedia of marketing*. *Part 4. Advertising and integrated communication*. John Wiley & Sons Ltd. doi: 10.1002/97 81444316568.wiem04010.

Nanda, S., & Warms, R. L. (2010). *Cultural anthropology*. Cengage Learning.

Nawi, N. C., Mamun, A. A., Nasir, N. A. M., & Muniady, R. (2019). Factors affecting the adoption of social media as a business platform: a study among student entrepreneurs in Malaysia. *Vision*, *23*(1), 1–11. doi: 10.1177/0972262918821200.

Newzoo (2018). 2018 games market: key numbers. Retrieved form https://newzoo.com/key-numbers.

Newzoo (2019). Newzoo's 2018 report: insights into the $137.9 billion global games market. Retrieved form https://newzoo.com/insights/articles/newzoos-2018-report-insights-into-the-137-9-billion-global-games-market.

Newzoo (2021). 2021 games market: key numbers. Retrieved form https://newzoo.com/key-numbers.

Ngai, E. W. T. (2003). Selection of web sites for online advertising using the AHP. *Information & Management, 40*(4)*,* 233–242. doi: 10.1016/s0378-7206(02)00004-6.

Paulson, C., Luo, L., & James, G. M. (2018). Efficient large-scale internet media selection optimization for online display advertising. *Journal of Marketing Research*, *55*(4), 489–506. doi: 10.1509/jmr.15.0307.

Pitt, H., Thomas, S. L., Bestman, A., Daube, M., & Derevensky, J. (2017). Factors that influence children's gambling attitudes and consumption intentions: lessons for gambling harm prevention research, policies and advocacy strategies. *Harm Reduction Journal*, *14*(1), 11. doi: 10.1186/s12954-017-0136-3.

Plantin, J. C., & Punathambekar, A. (2019). Digital media infrastructures: pipes, platforms, and politics. *Media, Culture & Society*, *41*(2), 163–174. doi: 10.1177/0163443718818376.

Reddick, C., & Anthopoulos, L. (2014). Interactions with e-government, new digital media and traditional channel choices: citizen-initiated factors. *Transforming Government: People, Process and Policy, 8*(3), 398–419. doi: 10.1108/TG-01-2014-0001.

Ramírez-Correa, P., Rondán-Cataluña, F. J., Arenas-Gaitán, J., & Martín-Velicia, F. (2019). Analysing the acceptation of online games in mobile devices: an application of UTAUT2. *Journal of Retailing and Consumer Services*, *50*, 85–93. doi: 10.1016/j.jretconser.2019.04.018.

Ruzgys, A., Volvačiovas, R., Ignatavičius, Č., & Turskis, Z. (2014). Integrated evaluation of external wall insulation in residential buildings using SWARA-TODIM MCDM method. *Journal of Civil Engineering and Management, 20*(1), 103–110. doi: 10.3846/13923730.2013.843585.

Sari, D. K., Suziana, S., & Games, D. (2020). An evaluation of social media advertising for Muslim millennial parents. *Journal of Islamic Marketing*. Advance online publication. doi: 10.1108/jima-02-2020-0055.

Skvarciany, V., Lapinskaitė, I., & Volskytė, G. (2021). Circular economy as assistance for sustainable development in OECD countries. *Oeconomia Copernicana, 12*(1), 11–34. doi: 10.24136/oc.2021.001.

Scharrer, E. (2004). Virtual violence: Gender and aggression in video game advertisements. *Mass Communication and Society, 7*(4), 393–412. doi: 10.1207/s15327825mcs0704_2.

Schouten, A. P., Janssen, L., & Verspaget, M. (2020). Celebrity vs. influencer endorsements in advertising: the role of identification, credibility, and product-endorser fit. *International Journal of Advertising*, *39*(2), 258–281. doi: 10.1080 /02650487.2019.1634898.

Shi, J., Potenza, M. N., & Turner, N. E. (2020). Commentary on: „The future of gaming disorder research and player protection: what role should the video gaming industry and researchers play?". *International Journal of Mental Health and Addiction, 18*, 791–799. doi: 10.1007/s11469-019-00153-7.

Shieber, J. (2019). Video game revenue tops $43 billion in 2018, an 18% jump from 2017. Tech crunch. Retrieved from https://techcrunch.com/2019/01/22/video-game-revenue-tops-43-billion-in-2018-an-18-jump-from-2017/?renderMode=ie (11.10.2019).

Siksnelyte-Butkiene, I., Streimikiene, D., Balezentis, T., & Skulskis, V. (2021). A systematic literature review of multi-criteria decision-making methods for sustainable selection of insulation materials in buildings. *Sustainability*, *13*(2), 737. doi: 10.3390/su13020737.

Smith, R., Kelly, B., Yeatman, H., Moore, C., Baur, L., King, L., Boyland, E., Chapman, K., Hughes, C., & Bauman, A. (2020). Advertising placement in digital game design influences children's choices of advertised snacks: a randomized trial. *Journal of the Academy of Nutrition and Dietetics*, *120*(3), 404–413. doi: 10.1016/j.jand.2019.07.017.

Stanujkic, D. (2016). An extension of the ratio system approach of MOORA method for group decision-making based on interval-valued triangular fuzzy numbers. *Technological and Economic Development of Economy, 22*(1), 122–141. doi: 10.3846/20294913.2015.1070771.

Stanujkic, D., Zavadskas, E. K., Brauers, W. K., & Karabasevic, D. (2015). An extension of the MULTIMOORA method for solving complex decision-making problems based on the use of interval-valued triangular fuzzy numbers. *Transformations in Business & Economics*, *14*(2B), 355–375.

Statista (2019). Unit sales of the best selling PC games of all time worldwide as of January 2018 (in Million Units). Retrieved form https://www.statista.com/statistics/275226/best-selling-pc-games-of-all-time-worldwide/ (12.02.2019).

Sudipa, I. G. I., Astria, C., Irnanda, K. F., Windarto, A. P., Daulay, N. K., Suharso, W., & Wijaya, H. O. L. (2020). Application of MCDM using PROMETHEE II technique in the case of social media selection for online businesses. *IOP Conference Series: Materials Science and Engineering, 835*(1), 012059.

Tafreshi, P. F., Aghdaie, M. H., Behzadian, M., & Abadi, M. G. (2016). Developing a group decision support system for advertising media evaluation: a case in the Middle East. *Group Decision and Negotiation*, *25*(5), 1021–1048. doi: 10.1007/s10726-015-9464-4.

Tavana, M., Momeni, E., Rezaeiniya, N., Mirhedayatian, S. M., & Rezaeiniya, H. (2013). A novel hybrid social media platform selection model using fuzzy ANP and COPRAS-G. *Expert Systems with Applications, 40*(14), 5694–5702. doi: 10.1016/j.eswa.2013.05.015.

Terlutter, R., & Capella, M. L. (2013). The gamification of advertising: analysis and research directions of in-game advertising, advergames, and advertising in social network games. *Journal of Advertising*, *42*(2-3), 95–112. doi: 10.1080/00913367.2013.774610.

Till, B. D., & Busler, M. (2000). The match-up hypothesis: physical attractiveness, expertise, and the role of fit on brand attitude, purchase intent and brand beliefs. *Journal of Advertising, 29*(3), 1–13. doi: 10.1080/00913367.2000.10673613.

Turskis, Z., Dzitac, S., Stankiuviene, A., & Šukys, R. (2019). A fuzzy group decision-making model for determining the most influential persons in the sustainable prevention of accidents in the construction SMEs. *International Journal of Computers Communications & Control, 14*(1), 90–106. doi:10.15837/ijccc.2019.1.3364.

Turskis, Z., Lazauskas, M., & Zavadskas, E. K. (2012). Fuzzy multiple criteria assessment of construction site alternatives for non-hazardous waste incineration plant in Vilnius city, applying ARAS-F and AHP methods. *Journal of Environmental Engineering and Landscape Management*, *20*(2), 110–120. doi: 10.3846/16486897.2011.645827.

Turskis, Z., Zavadskas, E. K., & Kutut, V. (2013). A model based on ARAS-G and AHP methods for multiple criteria prioritizing of heritage value. *International Journal of Information Technology & Decision Making*, *12*(01), 45–73. doi: 10.1142/S021962201350003X.

Turskis, Z., & Zavadskas, E. K. (2010a). A new fuzzy additive ratio assessment method (ARAS-F). Case study: the analysis of fuzzy multiple criteria in order to select the logistic centers location. *Transport, 25*(4), 423–432. doi: 10.3846/transport.2010.52.

Turskis, Z., & Zavadskas, E. K. (2010b). A novel method for multiple criteria analysis: grey additive ratio assessment (ARAS-G) method. *Informatica, 21*(4), 597–610.

Vahdani, B., Mousavi, S. M., Tavakkoli-Moghaddam, R., Ghodratnama, A., & Mohammadi, M. (2014). Robot selection by a multiple criteria complex proportional assessment method under an interval-valued fuzzy environment. *International Journal of Advanced Manufacturing Technology*, *73*(5-8), 687–697. doi: 10.1007/s00170-014-5849-9.

Valaei, N., Bressolles, G., Nikhashemi, S. R., & Khan, H. (2019). In-game advertising and gamers' behavior in app environment: an abstract. In *Academy of Marketing Science Annual Conference*. Springer, Cham. 387–388. doi: 10.1007/978-3-030-39165-2152.

Wang, H., & Sparks, C. (2019). Marketing credibility: Chinese newspapers' responses to revenue losses from falling circulation and advertising decline. *Journalism Studies*, *20*(9), 1301–1318. doi: 10.1080/1461670X.2018.1513815.

Wijman, T. (2020). The world's 2.7 billion gamers will spend $159.3 billion on games in 2020; the market will surpass $200 billion by 2023. Dipetik dari. Retrieved form https://newzoo.com/insights/articles/newzoo-games-market-numbers-revenues-and-audience-2020-2023/pada, 8.

Wilbur, K. C., & Zhu, Y. (2009). Click fraud. *Marketing Science*, *28*(2), 293–308. doi: 10.1287/mksc.1080.0397.

Yao, J. S., & Lin, F. T. (2002). Constructing a fuzzy flow-shop sequencing model based on statistical data. *International Journal of Approximate Reasoning, 29*(3), 215–234. doi: 10.1016/S0888-613X(01)00064-0.

Zadeh, L. A. (1975). The concept of a linguistic variable and its application to approximate reasoning—I. *Information Sciences*, *8*(3), 199–249. doi: 10.1016 /0020-0255(75)90036-5.

Zavadskas, E. K., & Turskis, Z. (2010). A new additive ratio assessment (ARAS) method in multicriteria decision-making. *Technological and Economic Development of Economy*, *16*(2), 159–172. doi: 10.3846/tede.2010.10.

Zavadskas, E. K., Turskis, Z., Šliogerienė, J., & Vilutienė, T. (2021). An integrated assessment of the municipal buildings' use including sustainability criteria. *Sustainable Cities and Society*, *67*, 102708. doi: 10.1016/j.scs.2021.102708.

Zavadskas, E. K., Turskis, Z., Vilutienė, T., & Lepkova, N. (2017). Integrated group fuzzy multi-criteria model: case of facilities management strategy selection. *Expert Systems with Applications, 82*, 317–331. doi: 10.1016/j.eswa.2017. 03.072.

Zha, X., Li, J., & Yan, Y. (2015). Advertising value and credibility transfer: attitude towards web advertising and online information acquisition. *Behaviour and Information Technology*, *34*(5), 520–532. doi: 10.1080/0144929X.2014.9 78380.

Zemlickienė, V., Bublienė, R., & Jakubavičius, A. (2018). A model for assessing the commercial potential of high technologies. *Oeconomia Copernicana*, *9*(1) 29–54. doi: 10.24136/oc.2018.002.

Zolfani, S. H., Torkayesh, A. E., Ecer, F., Turskis, Z., & Šaparauskas, J. (2021). International market selection: a MABA based EDAS analysis framework. *Oeconomia Copernicana, 12*(1), 99–124. doi: 10.24136/oc.2021.005.

Annex

Table 1. Criteria used in previous studies

Criteria	Ngai (2003)	Coutler & Sarkis (2005)	Krueger & Soley (2010)	Moorman *et al.* (2010)	Farzipoor Saen (2011)	Tavana *et al.* (2013)	Reddick & Anthopoulos (2014)	Ahmady *et al.* (2015)	Calli (2016)	Tafreshi *et al.* (2016)	Javan *et al.* (2018)	Alavijeh *et al.* (2019)	Nawi *et al.* (2019)	Sudipa *et al.* (2020)
Impression Rate	✓		✓			✓				✓				
Cost	✓	✓	✓	✓		✓		✓		✓		✓		
Audience Fit	✓	✓	✓			✓			✓					✓
Content	✓	✓				✓			✓					
Look & Feel	✓					✓								✓
Time		✓		✓								✓		
Coverage		✓										✓		✓
Size of Audience					✓									
Accuracy of Targeting					✓									
Durability of Media					✓									
Volume of supplied info					✓									
Digital Divide							✓			✓				
User satisfaction							✓		✓					
Nature of Interaction							✓							
Security and Privacy							✓							✓
Number of Circulation								✓						
Reputation								✓						
Irritation									✓					
Reach			✓	✓						✓				
Brand Penetration			✓							✓				
Brand Awareness										✓				
Advertising Awareness			✓							✓				

Table 1. Continued

Criteria	Ngai (2003)	Coutler & Sarkis (2005)	Krueger & Soley (2010)	Moorman *et al.* (2010)	Farzipoor Saen (2011)	Tavana *et al.* (2013)	Reddick & Anthopoulos (2014)	Ahmady *et al.* (2015)	Calli (2016)	Tafreshi *et al.* (2016)	Javan *et al.* (2018)	Alavijeh *et al.* (2019)	Nawi *et al.* (2019)	Sudipa *et al.* (2020)
Top of Mind										✓				
Attention			✓								✓	✓		
Interest											✓		✓	
Desire											✓			
Action											✓			
Performance Expectancy													✓	
Perceived Trust													✓	
Facilitating Conditions													✓	✓
Perceived Risk													✓	
Social Influence													✓	
Frequency			✓	✓								✓		
Oldness of the Message												✓		
Frequency of Competitors' Campaign			✓											

Table 2. Linguistic variables for weighting criteria

Linguistic Variables	**Interval-Valued Triangular Fuzzy Number**
Equally important	[(0.75, 0.8); 0.9; (0.9, 0.9)]
Moderately less important	[(0.55, 0.6); 0.7; (0.8, 0.85)]
Less important	[(0.35, 0.4); 0.5; (0.6, 0.65)]
Very less important	[(0.15, 0.2); 0.3; (0.4, 0.45)]
Much less important	[(0.1, 0.1); 0.1; (0.2, 0.25)]

Source: Stanujkic *et al*. (2015).

Table 3. Calculations of the criteria weights for the first expert

Criteria Code		Comparative importance of average value $\tilde{S}_j$	Coefficient $\tilde{k}_j = \tilde{S}_j+1$	Recalculated weight $\tilde{q}_j$	Weight ($\tilde{w}_j$)
Main	C2		[(1,1),1,(1,1)]	[(1,1),1,(1,1)]	[(0.451,0.463),0.486,(0.507,0.517)]
	C1	[(0.35,0.4),0.5,(0.6,0.65)]	[(1.35,1.4),1.5,(1.6,1.65)]	[(0.606,0.625),0.667,(0.714,0.741)]	[(0.273,0.289),0.324,(0.362,0.383)]
	C3	[(0.55,0.6),0.7,(0.8,0.85)]	[(1.55,1.6),1.7,(1.8,1.85)]	[(0.328,0.347),0.392,(0.446,0.478)]	[(0.148,0.161),0.19,(0.226,0.247)]
C1	C11	0	[(1,1),1,(1,1)]	[(1,1),1,(1,1)]	[(0.38,0.396),0.426,(0.451,0.463)]
	C12	[(0.55,0.6),0.7,(0.8,0.85)]	[(1.55,1.6),1.7,(1.8,1.85)]	[(0.541,0.556),0.588,(0.625,0.645)]	[(0.205,0.22),0.251,(0.282,0.299)]
	C15	[(0.35,0.4),0.5,(0.6,0.65)]	[(1.35,1.4),1.5,(1.6,1.65)]	[(0.328,0.347),0.392,(0.446,0.478)]	[(0.124,0.137),0.167,(0.201,0.221)]
	C14	[(0.75,0.8),0.9,(0.9,0.9)]	[(1.75,1.8),1.9,(1.9,1.9)]	[(0.172,0.183),0.206,(0.248,0.273)]	[(0.065,0.072),0.088,(0.112,0.126)]
	C13	[(0.15,0.2),0.3,(0.4,0.45)]	[(1.15,1.2),1.3,(1.4,1.45)]	[(0.119,0.131),0.159,(0.207,0.237)]	[(0.045,0.052),0.068,(0.093,0.11)]
C2	C24	0	[(1,1),1,(1,1)]	[(1,1),1,(1,1)]	[(0.372,0.391),0.425,(0.443,0.451)]
	C25	[(0.75,0.8),0.9,(0.9,0.9)]	[(1.75,1.8),1.9,(1.9,1.9)]	[(0.526,0.526),0.526,(0.556,0.571)]	[(0.196,0.206),0.224,(0.246,0.258)]
	C23	[(0.35,0.4),0.5,(0.6,0.65)]	[(1.35,1.4),1.5,(1.6,1.65)]	[(0.319,0.329),0.351,(0.397,0.423)]	[(0.119,0.128),0.149,(0.176,0.191)]
	C26	[(0.35,0.4),0.5,(0.6,0.65)]	[(1.35,1.4),1.5,(1.6,1.65)]	[(0.193,0.206),0.234,(0.283,0.314)]	[(0.072,0.08),0.099,(0.126,0.142)]
	C22	[(0.55,0.6),0.7,(0.8,0.85)]	[(1.55,1.6),1.7,(1.8,1.85)]	[(0.104,0.114),0.138,(0.177,0.202)]	[(0.039,0.045),0.058,(0.079,0.091)]
	C21	[(0.15,0.2),0.3,(0.4,0.45)]	[(1.15,1.2),1.3,(1.4,1.45)]	[(0.072,0.082),0.106,(0.148,0.176)]	[(0.027,0.032),0.045,(0.065,0.079)]
C3	C31	0	[(1,1),1,(1,1)]	[(1,1),1,(1,1)]	[(0.315,0.333),0.367,(0.399,0.414)]
	C32	[(0.35,0.4),0.5,(0.6,0.65)]	[(1.35,1.4),1.5,(1.6,1.65)]	[(0.606,0.625),0.667,(0.714,0.741)]	[(0.191,0.208),0.245,(0.285,0.307)]
	C34	[(0.15,0.2),0.3,(0.4,0.45)]	[(1.15,1.2),1.3,(1.4,1.45)]	[(0.418,0.446),0.513,(0.595,0.644)]	[(0.132,0.149),0.188,(0.238,0.267)]
	C33	[(0.35,0.4),0.5,(0.6,0.65)]	[(1.35,1.4),1.5,(1.6,1.65)]	[(0.253,0.279),0.342,(0.425,0.477)]	[(0.08,0.093),0.126,(0.17,0.198)]
	C35	[(0.55,0.6),0.7,(0.8,0.85)]	[(1.55,1.6),1.7,(1.8,1.85)]	[(0.137,0.155),0.201,(0.266,0.308)]	[(0.043,0.052),0.074,(0.106,0.128)]

Table 4. Aggregation of the proposed weights and calculation of the final criteria weights by the experts

Criteria	Code	DM1	DM2	DM3	DM4
Main	C1	(0.273, 0.289,0.324,0.362,0.383)	(0.265, 0.281,0.316,0.354,0.375)	(0.236, 0.25,0.279,0.31,0.327)	(0.28, 0.296,0.33,0.366,0.385)
	C2	(0.451, 0.463,0.486,0.507,0.517)	(0.437, 0.45,0.474,0.496,0.507)	(0.437, 0.45,0.474,0.496,0.507)	(0.462, 0.474,0.496,0.512,0.519)
	C3	(0.148, 0.161,0.19,0.226,0.247)	(0.16, 0.176,0.211,0.253,0.278)	(0.143, 0.156,0.186,0.221,0.242)	(0.147, 0.156,0.174,0.203,0.22)
C1	C11	(0.38, 0.396,0.426,0.451,0.463)	(0.369, 0.385,0.415,0.437,0.447)	(0.194, 0.203,0.219,0.243,0.256)	(0.213, 0.231,0.27,0.319,0.345)
	C12	(0.205, 0.22,0.251,0.282,0.299)	(0.071, 0.079,0.097,0.124,0.14)	(0.369, 0.385,0.415,0.437,0.447)	(0.309, 0.324,0.351,0.382,0.397)
	C13	(0.045, 0.052,0.068,0.093,0.11)	(0.224, 0.241,0.277,0.312,0.331)	(0.064, 0.07,0.086,0.108,0.122)	(0.092, 0.107,0.144,0.181,0.203)
	C14	(0.065, 0.072,0.088,0.112,0.126)	(0.043, 0.049,0.065,0.088,0.104)	(0.044, 0.05,0.066,0.09,0.106)	(0.049, 0.056,0.076,0.101,0.116)
	C15	(0.124, 0.137,0.167,0.201,0.221)	(0.118, 0.127,0.146,0.173,0.189)	(0.105, 0.113,0.129,0.152,0.165)	(0.115, 0.128,0.159,0.199,0.223)
C2	C21	(0.027, 0.032,0.045,0.065,0.079)	(0.199, 0.214,0.246,0.28,0.298)	(0.114, 0.122,0.138,0.162,0.175)	(0.144, 0.161,0.202,0.238,0.257)
	C22	(0.039, 0.045,0.058,0.079,0.091)	(0.021, 0.026,0.038,0.056,0.068)	(0.018, 0.02,0.025,0.035,0.042)	(0.024, 0.028,0.037,0.052,0.062)
	C23	(0.119, 0.128,0.149,0.176,0.191)	(0.368, 0.386,0.418,0.448,0.462)	(0.217, 0.231,0.262,0.291,0.306)	(0.18, 0.194,0.222,0.261,0.283)
	C24	(0.372, 0.391,0.425,0.443,0.451)	(0.065, 0.074,0.096,0.125,0.143)	(0.401, 0.417,0.446,0.466,0.475)	(0.298, 0.31,0.333,0.366,0.382)
	C25	(0.196, 0.206,0.224,0.246,0.258)	(0.108, 0.119,0.145,0.175,0.192)	(0.062, 0.068,0.081,0.101,0.113)	(0.087, 0.101,0.135,0.17,0.19)
	C26	(0.072, 0.08,0.099,0.126,0.142)	(0.035, 0.041,0.057,0.078,0.092)	(0.033, 0.038,0.048,0.063,0.073)	(0.046, 0.053,0.071,0.094,0.109)
C3	C31	(0.315, 0.333,0.367,0.399,0.414)	(0.037, 0.044,0.061,0.085,0.1)	(0.33, 0.347,0.378,0.405,0.418)	(0.378, 0.395,0.427,0.442,0.449)
	C32	(0.191, 0.208,0.245,0.285,0.307)	(0.128, 0.142,0.176,0.217,0.241)	(0.045, 0.052,0.069,0.098,0.116)	(0.044, 0.049,0.061,0.081,0.095)
	C33	(0.08, 0.093,0.126,0.17,0.198)	(0.069, 0.079,0.103,0.136,0.155)	(0.228, 0.248,0.291,0.337,0.363)	(0.199, 0.208,0.225,0.246,0.257)
	C34	(0.132, 0.149,0.188,0.238,0.267)	(0.211, 0.228,0.264,0.304,0.325)	(0.065, 0.072,0.09,0.117,0.134)	(0.083, 0.093,0.115,0.146,0.165)
	C35	(0.043, 0.052,0.074,0.106,0.128)	(0.348, 0.365,0.396,0.425,0.439)	(0.123, 0.138,0.171,0.211,0.234)	(0.137, 0.148,0.173,0.205,0.223)

Table 4. Continued

	Criteria Code	DM5	DM6	Aggregation	BNP	Local Weight	Final Weight	Rank
Main	C1	(0.273, 0.289,0.324,0.362,0.383)	(0.23, 0.237,0.249,0.276,0.29)	(0.259, 0.273,0.302,0.337,0.355)	0.305046196	0.3127	---	2
	C2	(0.451, 0.463,0.486,0.507,0.517)	(0.437, 0.45,0.474,0.496,0.507)	(0.446, 0.458,0.481,0.502,0.512)	0.479873511	0.4919	----	1
	C3	(0.148, 0.161,0.19,0.226,0.247)	(0.139, 0.148,0.166,0.197,0.214)	(0.147, 0.159,0.186,0.22,0.241)	0.190695936	0.1955	---	3
C1	C11	(0.21, 0.219,0.235,0.256,0.267)	(0.21, 0.219,0.235,0.256,0.267)	(0.252, 0.264,0.288,0.316,0.331)	0.27463096	0.3192	0.09979702	4
	C12	(0.399, 0.415,0.446,0.461,0.468)	(0.399, 0.415,0.446,0.461,0.468)	(0.254, 0.268,0.298,0.328,0.343)	0.28040839	0.3259	0.10189646	3
	C13	(0.069, 0.076,0.092,0.114,0.128)	(0.069, 0.076,0.092,0.114,0.128)	(0.081, 0.09,0.112,0.14,0.157)	0.100764378	0.1171	0.03661636	10
	C14	(0.047, 0.054,0.071,0.095,0.111)	(0.047, 0.054,0.071,0.095,0.111)	(0.049, 0.056,0.072,0.097,0.112)	0.064480114	0.0749	0.02343116	14
	C15	(0.127, 0.137,0.156,0.183,0.198)	(0.127, 0.137,0.156,0.183,0.198)	(0.119, 0.129,0.152,0.181,0.198)	0.140152553	0.1629	0.05092946	8
C2	C21	(0.103, 0.117,0.15,0.192,0.216)	(0.121, 0.129,0.145,0.165,0.177)	(0.102, 0.113,0.137,0.168,0.185)	0.124175628	0.1467	0.07215775	5
	C22	(0.039, 0.05,0.081,0.121,0.148)	(0.018, 0.02,0.024,0.032,0.037)	(0.025, 0.029,0.04,0.056,0.067)	0.035078605	0.0414	0.02038398	16
	C23	(0.17, 0.188,0.226,0.269,0.291)	(0.224, 0.232,0.247,0.265,0.274)	(0.201, 0.214,0.242,0.274,0.291)	0.226406816	0.2675	0.13156371	2
	C24	(0.281, 0.301,0.338,0.376,0.394)	(0.426, 0.441,0.468,0.477,0.48)	(0.265, 0.281,0.314,0.345,0.361)	0.294190702	0.3476	0.17095254	1
	C25	(0.071, 0.084,0.116,0.16,0.188)	(0.064, 0.068,0.076,0.092,0.101)	(0.09, 0.099,0.121,0.149,0.165)	0.109588574	0.1295	0.0636813	7
	C26	(0.049, 0.06,0.089,0.133,0.163)	(0.034, 0.036,0.04,0.051,0.058)	(0.043, 0.049,0.064,0.086,0.1)	0.057009843	0.0674	0.0331281	12
C3	C31	(0.386, 0.401,0.43,0.448,0.456)	(0.427, 0.44,0.466,0.476,0.481)	(0.25, 0.266,0.3,0.33,0.346)	0.278976448	0.3444	0.067313	6
	C32	(0.06, 0.069,0.092,0.115,0.13)	(0.051, 0.056,0.069,0.083,0.092)	(0.073, 0.081,0.102,0.13,0.146)	0.091653374	0.1131	0.02211464	15
	C33	(0.203, 0.211,0.226,0.249,0.261)	(0.225, 0.232,0.245,0.264,0.275)	(0.15, 0.163,0.19,0.224,0.243)	0.175311971	0.2164	0.04230025	9
	C34	(0.075, 0.082,0.101,0.127,0.143)	(0.064, 0.068,0.076,0.092,0.101)	(0.095, 0.104,0.126,0.156,0.174)	0.114969319	0.1419	0.02774044	13
	C35	(0.123, 0.132,0.151,0.178,0.193)	(0.121, 0.129,0.144,0.165,0.177)	(0.125, 0.137,0.163,0.196,0.215)	0.149175217	0.1841	0.03599383	11

Table 5. Linguistic variables for ranking the alternatives

Linguistic Variables	Interval-Valued Triangular Fuzzy Number
Very High (VH)	[(0.75, 0.8); 0.9; (0.9, 0.9)]
High (H)	[(0.55, 0.6); 0.7; (0.8, 0.85)]
Medium (M)	[(0.35, 0.4); 0.5; (0.6, 0.65)]
Low (L)	[(0.15, 0.2); 0.3; (0.4, 0.45)]
Very Low (VL)	[(0.1, 0.1); 0.1; (0.2, 0.25)]

Source: Stanujkic *et al*. (2015).

Table 6. Decision table based on expert opinions

DMs	Criteria		Online Media				Offline Media					
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
DM1	C1	C11	L	H	M	VH	L	H	M	M	L	H
		C12	L	VH	M	H	L	H	VL	L	VL	H
		C13	M	M	L	H	H	VH	VL	M	L	VH
		C14	L	H	M	M	M	H	L	M	M	H
		C15	M	H	M	VH	H	VH	L	M	L	H
	C2	C21	M	VH	M	VH	M	H	VL	M	M	VH
		C22	VH	VH	H	VH	VL	M	VL	VL	VL	L
		C23	H	VH	M	H	L	VH	H	M	L	VL
		C24	VH	H	M	VH	M	H	VL	M	VL	H
		C25	M	H	L	VH	L	H	H	M	L	VH
		C26	H	H	M	VH	H	VH	H	H	L	M
	C3	C31	VL	L	M	L	H	M	VH	H	VH	H
		C32	VH	VH	M	H	M	L	VL	M	L	VH
		C33	M	H	M	M	L	L	H	L	L	VL
		C34	L	L	VL	VL	VH	VH	M	VH	M	L
		C35	M	L	VL	VL	VH	VH	H	H	M	M

DMs	Criteria		Online Media				Offline Media					
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
DM2	C1	C11	VH	VH	L	M	L	M	VL	VL	L	H
		C12	H	VH	L	L	L	H	VL	L	L	H
		C13	H	VH	L	M	VL	L	VL	VL	H	VH
		C14	H	H	M	M	VL	H	VL	VL	H	M
		C15	M	H	M	VH	M	H	M	L	H	H
	C2	C21	VH	VH	L	H	M	H	M	L	M	M
		C22	H	H	M	H	VL	H	M	L	L	H
		C23	VH	VH	H	VH	M	VH	VH	H	H	L
		C24	VH	VH	L	H	VL	L	L	VL	VL	L
		C25	M	VH	L	M	L	M	L	L	M	M
		C26	VH	VH	VH	VH	VL	M	H	VL	M	M
	C3	C31	VL	VL	VL	VL	VH	M	M	VH	VH	M
		C32	VH	VH	VH	VH	VL	VL	M	VL	M	M
		C33	H	H	H	M	VL	VL	L	VL	VL	VL
		C34	M	H	L	L	H	VH	H	VH	VH	M
		C35	L	L	M	H	H	M	H	H	H	L

DMs	Criteria		Online Media				Offline Media					
			A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
DM3	C1	C11	H	VH	L	VH	H	L	VL	M	L	M
		C12	VH	H	M	M	L	VH	VL	M	M	H
		C13	H	H	M	VH	VL	VH	VL	VL	M	M
		C14	M	H	L	L	L	VH	VL	VL	H	H
		C15	H	H	H	VH	VL	H	VL	VL	H	H
	C2	C21	H	VH	L	VH	VL	L	VL	VL	L	L
		C22	VH	VH	VH	VH	VL	VL	L	VL	L	M
		C23	H	VH	M	VH	VH	VH	M	M	L	M
		C24	VH	VH	VH	VH	VL	L	L	VL	VL	H
		C25	H	VH	L	VH	L	H	VL	M	M	H
		C26	H	H	H	H	VL	L	H	VL	M	H
	C3	C31	L	VL	L	VL	VH	L	L	VH	VH	M
		C32	VH	VH	VH	VH	VL	VL	M	VL	M	M
		C33	M	H	VL	L	VL	VL	M	VL	VL	L
		C34	M	L	VL	VL	VH	VH	H	H	VH	VH
		C35	M	M	M	L	VH	VH	M	H	H	H

Table 6. Continued

DMs	Criteria		Online Media A1	Online Media A2	Online Media A3	Online Media A4	Offline Media A5	Offline Media A6	Offline Media A7	Offline Media A8	Offline Media A9	Offline Media A10
DM4	C1	C11	L	H	VL	VH	M	H	L	M	VL	VL
		C12	VL	VH	VL	L	H	H	VL	VL	VL	M
		C13	M	H	VL	VH	M	M	VL	L	VL	L
		C14	VL	H	H	VH	L	H	M	L	M	M
		C15	M	M	L	VH	H	H	VL	L	M	M
	C2	C21	VL	VH	L	VH	M	M	L	L	L	L
		C22	H	VH	L	M	L	L	VL	VL	L	M
		C23	M	M	L	H	M	H	H	L	VL	VL
		C24	H	VH	M	VH	VL	L	M	VL	VL	M
		C25	M	VH	VL	M	VL	L	M	VL	VL	L
		C26	M	VH	VL	VH	H	H	VH	L	VL	VL
	C3	C31	M	VH	L	VL	L	VL	VL	L	L	L
		C32	H	H	M	H	M	M	VH	M	M	M
		C33	H	H	M	L	VH	VH	VH	M	VL	VL
		C34	M	VH	VL	VL	L	VH	VL	L	VL	VL
		C35	L	L	L	L	VH	VH	L	M	M	M
DM5	C1	C11	H	VH	M	H	L	VL	VL	M	VL	L
		C12	M	H	M	H	H	H	L	M	VL	M
		C13	M	M	L	H	H	H	VL	L	M	L
		C14	H	M	VL	M	VL	H	VL	L	M	L
		C15	M	M	L	H	H	VH	VL	L	M	L
	C2	C21	H	VH	M	H	M	L	VL	L	L	M
		C22	H	H	M	H	VL	VL	L	VL	VL	L
		C23	VH	VH	M	VH	L	H	H	M	M	VL
		C24	VH	VH	H	VH	M	M	M	M	L	L
		C25	H	VH	M	H	L	M	L	L	VL	L
		C26	VH	H	L	H	H	H	H	H	L	M
	C3	C31	L	L	L	M	VL	VL	L	VL	L	L
		C32	H	H	M	M	L	L	VL	L	VL	L
		C33	H	H	L	VL	L	L	L	VL	L	L
		C34	L	L	L	M	H	VH	L	H	H	H
		C35	L	VL	VL	L	H	VH	M	H	H	M
DM6	C1	C11	VH	VH	VL	VH	VL	L	H	VL	M	H
		C12	VH	VH	M	VH	M	L	M	L	H	H
		C13	VH	VH	VH	VH	H	H	H	M	H	H
		C14	M	VH	M	M	VL	H	L	VL	H	VH
		C15	H	VH	H	VH	M	M	H	L	M	H
	C2	C21	H	VH	M	H	L	L	L	L	H	VH
		C22	VH	M	H	VH	VL	VL	VL	VL	VL	VH
		C23	VH	VH	VH	VH	M	VH	VH	VH	VH	H
		C24	VH	VH	H	H	VL	VL	H	VL	M	VH
		C25	H	VH	L	VH	L	L	M	L	H	H
		C26	M	M	H	H	VL	VL	H	VL	VL	L
	C3	C31	H	H	H	H	VL	M	M	VL	L	L
		C32	VH	VH	H	VH	L	VL	H	L	H	VH
		C33	M	M	L	L	M	M	H	M	M	H
		C34	M	M	M	M	M	M	M	M	M	M
		C35	L	L	M	H	VH	VH	H	VH	VH	VH

Table 7. Weighted-normalized decision table

Criteria	Code	Ideal	A1	A2	A3	A4	A5
C1 (+)	C11	[(0.007,0.008),0.011,(0.014, 0.016)]	[(0.004,0.005),0.008,(0.011, 0.012)]	[(0.007,0.008),0.011,(0.014, 0.016)]	[(0.002,0.002),0.003,(0.006, 0.007)]	[(0.006,0.007),0.01,(0.013,0 .015)]	[(0.002,0.003),0.004,(0.007, 0.009)]
	C12	[(0.006,0.008),0.011,(0.014, 0.016)]	[(0.003,0.004),0.006,(0.009, 0.011)]	[(0.006,0.008),0.011,(0.014, 0.016)]	[(0.002,0.003),0.005,(0.007, 0.009)]	[(0.003,0.004),0.007,(0.01,0 .012)]	[(0.003,0.003),0.006,(0.009, 0.01)]
	C13	[(0.002,0.002),0.004,(0.005, 0.007)]	[(0.001,0.002),0.003,(0.005, 0.006)]	[(0.002,0.002),0.003,(0.005, 0.006)]	[(0.001,0.001),0.002,(0.003, 0.004)]	[(0.002,0.002),0.004,(0.005, 0.007)]	[(0.001,0.001),0.002,(0.003, 0.004)]
	C14	[(0.001,0.001),0.002,(0.004, 0.005)]	[(0.001,0.001),0.001,(0.002, 0.003)]	[(0.001,0.001),0.002,(0.004, 0.005)]	[(0,0.001),0.001,(0.002,0.00 3)]	[(0.001,0.001),0.002,(0.003, 0.004)]	[(0,0),0.001,(0.001,0.002)]
	C15	[(0.003,0.004),0.005,(0.007, 0.008)]	[(0.002,0.002),0.003,(0.005, 0.007)]	[(0.002,0.003),0.004,(0.006, 0.007)]	[(0.001,0.002),0.003,(0.005, 0.006)]	[(0.003,0.004),0.005,(0.007, 0.008)]	[(0.001,0.002),0.003,(0.005, 0.006)]
C2 (+)	C21	[(0.005,0.006),0.009,(0.011, 0.012)]	[(0.003,0.003),0.005,(0.007, 0.009)]	[(0.005,0.006),0.009,(0.011, 0.012)]	[(0.001,0.002),0.004,(0.006, 0.007)]	[(0.004,0.005),0.008,(0.01,0 .012)]	[(0.002,0.002),0.003,(0.006, 0.007)]
	C22	[(0.001,0.001),0.002,(0.004, 0.005)]	[(0.001,0.001),0.002,(0.004, 0.005)]	[(0.001,0.001),0.002,(0.004, 0.004)]	[(0.001,0.001),0.002,(0.003, 0.004)]	[(0.001,0.001),0.002,(0.004, 0.004)]	[(0,0),0,(0.001,0.001)]
	C23	[(0.008,0.009),0.012,(0.015, 0.016)]	[(0.007,0.008),0.011,(0.014, 0.015)]	[(0.007,0.009),0.012,(0.014, 0.016)]	[(0.004,0.005),0.008,(0.011, 0.012)]	[(0.008,0.009),0.012,(0.015, 0.016)]	[(0.003,0.004),0.007,(0.01,0 .011)]
	C24	[(0.012,0.014),0.019,(0.022, 0.024)]	[(0.012,0.014),0.019,(0.022, 0.024)]	[(0.012,0.014),0.019,(0.022, 0.024)]	[(0.007,0.009),0.012,(0.017, 0.019)]	[(0.012,0.014),0.018,(0.022, 0.024)]	[(0.003,0.003),0.004,(0.007, 0.009)]
	C25	[(0.004,0.005),0.007,(0.01,0 .011)]	[(0.003,0.003),0.005,(0.008, 0.009)]	[(0.004,0.005),0.007,(0.01,0 .011)]	[(0.001,0.001),0.002,(0.004, 0.005)]	[(0.003,0.004),0.006,(0.008, 0.01)]	[(0.001,0.001),0.002,(0.004, 0.005)]
	C26	[(0.002,0.002),0.003,(0.005, 0.006)]	[(0.001,0.002),0.003,(0.004, 0.006)]	[(0.001,0.002),0.003,(0.005, 0.006)]	[(0.001,0.001),0.002,(0.003, 0.004)]	[(0.002,0.002),0.003,(0.005, 0.006)]	[(0.001,0.001),0.001,(0.002, 0.003)]
C3 (-)	C31	[(0.006,0.009),0.018,(0.026, 0.033)]	[(0.006,0.008),0.015,(0.023, 0.031)]	[(0.005,0.007),0.013,(0.021, 0.027)]	[(0.005,0.007),0.012,(0.021, 0.029)]	[(0.006,0.009),0.018,(0.026, 0.033)]	[(0.005,0.006),0.011,(0.017, 0.021)]
	C32	[(0.002,0.003),0.006,(0.011, 0.015)]	[(0.001,0.001),0.001,(0.002, 0.003)]	[(0.001,0.001),0.001,(0.002, 0.003)]	[(0.001,0.001),0.002,(0.003, 0.004)]	[(0.001,0.001),0.002,(0.003, 0.004)]	[(0.002,0.002),0.005,(0.009, 0.012)]
	C33	[(0.003,0.004),0.008,(0.013, 0.018)]	[(0.001,0.002),0.003,(0.004, 0.006)]	[(0.001,0.001),0.002,(0.004, 0.005)]	[(0.002,0.002),0.004,(0.008, 0.011)]	[(0.002,0.003),0.005,(0.01,0 .014)]	[(0.002,0.003),0.006,(0.01,0 .013)]
	C34	[(0.002,0.004),0.008,(0.014, 0.019)]	[(0.002,0.002),0.004,(0.007, 0.01)]	[(0.001,0.002),0.003,(0.006, 0.01)]	[(0.002,0.004),0.008,(0.014, 0.019)]	[(0.002,0.003),0.007,(0.012, 0.016)]	[(0.001,0.002),0.002,(0.004, 0.006)]
	C35	[(0.003,0.004),0.008,(0.016, 0.023)]	[(0.003,0.003),0.006,(0.012, 0.019)]	[(0.003,0.004),0.008,(0.016, 0.023)]	[(0.003,0.004),0.008,(0.014, 0.019)]	[(0.003,0.003),0.007,(0.012, 0.017)]	[(0.001,0.002),0.003,(0.004, 0.006)]

Table 7. Continued

Criteria	Code	A6	A7	A8	A9	A10
C1 (+)	C11	[(0.002,0.003),0.005,(0.008,0.01)]	[(0.002,0.002),0.003,(0.005,0.007)]	[(0.002,0.003),0.004,(0.007,0.008)]	[(0.003,0.004),0.005,(0.009,0.011)]	[(0.002,0.003),0.005,(0.008,0.01)]
	C12	[(0.004,0.006),0.008,(0.012,0.014)]	[(0.001,0.002),0.002,(0.004,0.006)]	[(0.002,0.002),0.004,(0.007,0.008)]	[(0.005,0.006),0.008,(0.012,0.014)]	[(0.004,0.006),0.008,(0.012,0.014)]
	C13	[(0.001,0.002),0.003,(0.005,0.006)]	[(0,0),0.001,(0.002,0.002)]	[(0.001,0.001),0.001,(0.002,0.003)]	[(0.001,0.002),0.003,(0.004,0.005)]	[(0.001,0.002),0.003,(0.005,0.006)]
	C14	[(0.001,0.001),0.002,(0.004,0.005)]	[(0,0),0.001,(0.001,0.002)]	[(0,0),0.001,(0.001,0.002)]	[(0.001,0.001),0.002,(0.003,0.004)]	[(0.001,0.001),0.002,(0.004,0.005)]
	C15	[(0.002,0.003),0.004,(0.006,0.008)]	[(0.001,0.001),0.001,(0.003,0.004)]	[(0.001,0.001),0.002,(0.003,0.004)]	[(0.002,0.002),0.003,(0.005,0.007)]	[(0.002,0.003),0.004,(0.006,0.008)]
C2 (+)	C21	[(0.002,0.002),0.004,(0.006,0.008)]	[(0.001,0.001),0.002,(0.004,0.005)]	[(0.001,0.001),0.003,(0.005,0.006)]	[(0.002,0.003),0.005,(0.007,0.009)]	[(0.002,0.002),0.004,(0.006,0.008)]
	C22	[(0,0),0.001,(0.001,0.002)]	[(0,0),0.001,(0.001,0.002)]	[(0,0),0,(0.001,0.001)]	[(0.001,0.001),0.001,(0.003,0.003)]	[(0,0),0.001,(0.001,0.002)]
	C23	[(0.008,0.009),0.012,(0.015,0.016)]	[(0.006,0.008),0.01,(0.014,0.015)]	[(0.004,0.005),0.008,(0.011,0.012)]	[(0.002,0.002),0.003,(0.006,0.007)]	[(0.008,0.009),0.012,(0.015,0.016)]
	C24	[(0.003,0.004),0.007,(0.011,0.013)]	[(0.004,0.005),0.007,(0.011,0.014)]	[(0.003,0.003),0.004,(0.007,0.009)]	[(0.006,0.008),0.011,(0.015,0.018)]	[(0.003,0.004),0.007,(0.011,0.013)]
	C25	[(0.002,0.002),0.004,(0.006,0.008)]	[(0.001,0.002),0.003,(0.005,0.006)]	[(0.001,0.001),0.002,(0.004,0.006)]	[(0.002,0.003),0.004,(0.007,0.008)]	[(0.002,0.002),0.004,(0.006,0.008)]
	C26	[(0.001,0.001),0.002,(0.003,0.004)]	[(0.002,0.002),0.003,(0.005,0.006)]	[(0,0.001),0.001,(0.002,0.003)]	[(0.001,0.001),0.002,(0.003,0.004)]	[(0.001,0.001),0.002,(0.003,0.004)]
C3 (-)	C31	[(0.006,0.008),0.014,(0.022,0.029)]	[(0.005,0.006),0.011,(0.018,0.024)]	[(0.005,0.006),0.011,(0.017,0.021)]	[(0.004,0.006),0.009,(0.017,0.023)]	[(0.006,0.008),0.014,(0.022,0.029)]
	C32	[(0.002,0.003),0.006,(0.011,0.015)]	[(0.001,0.002),0.003,(0.006,0.007)]	[(0.002,0.002),0.005,(0.009,0.012)]	[(0.001,0.001),0.002,(0.004,0.005)]	[(0.002,0.003),0.006,(0.011,0.015)]
	C33	[(0.002,0.003),0.006,(0.01,0.013)]	[(0.001,0.002),0.003,(0.005,0.007)]	[(0.003,0.003),0.007,(0.012,0.016)]	[(0.003,0.004),0.008,(0.013,0.017)]	[(0.002,0.003),0.006,(0.01,0.013)]
	C34	[(0.001,0.001),0.002,(0.003,0.004)]	[(0.002,0.002),0.004,(0.007,0.009)]	[(0.001,0.002),0.002,(0.004,0.006)]	[(0.002,0.002),0.004,(0.006,0.009)]	[(0.001,0.001),0.002,(0.003,0.004)]
	C35	[(0.002,0.002),0.003,(0.004,0.006)]	[(0.002,0.002),0.004,(0.007,0.01)]	[(0.002,0.002),0.003,(0.005,0.007)]	[(0.002,0.002),0.004,(0.007,0.01)]	[(0.002,0.002),0.003,(0.004,0.006)]

Table 8. Final ranking results for different values of λ

	$\tilde{S}_i$	λ =0			λ =0.5			λ =1		
		BNP	K_i	**Rank**	**BNP**	K_i	**Rank**	**BNP**	K_i	**Rank**
Ideal	[(0.067,0.083),0.133,(0.19,0.233)]	0.0870	1.0000	0	0.0840	1.0000	0	0.0810	1.0000	0
A1	[(0.049,0.061),0.094,(0.141,0.175)]	0.0640	0.7350	3	0.0610	0.7320	3	0.0590	0.7280	3
A2	[(0.061,0.074),0.111,(0.157,0.19)]	0.0720	0.8370	2	0.0700	0.8390	2	0.0680	0.8420	2
A3	[(0.035,0.046),0.078,(0.126,0.163)]	0.0550	0.6360	5	0.0530	0.6260	5	0.0500	0.6140	5
A4	[(0.058,0.072),0.115,(0.165,0.201)]	0.0750	0.8650	1	0.0730	0.8660	1	0.0710	0.8680	1
A5	[(0.028,0.035),0.059,(0.098,0.126)]	0.0420	0.4890	8	0.0400	0.4810	8	0.0380	0.4720	8
A6	[(0.04,0.051),0.083,(0.128,0.159)]	0.0560	0.6500	4	0.0540	0.6460	4	0.0520	0.6420	4
A7	[(0.03,0.037),0.059,(0.098,0.127)]	0.0430	0.4960	7	0.0410	0.4870	7	0.0390	0.4770	7
A8	[(0.027,0.034),0.058,(0.097,0.125)]	0.0420	0.4840	9	0.0400	0.4750	9	0.0380	0.4660	9
A9	[(0.026,0.033),0.054,(0.094,0.123)]	0.0410	0.4700	10	0.0390	0.4590	10	0.0360	0.4480	10
A10	[(0.036,0.046),0.075,(0.121,0.154)]	0.0530	0.6120	6	0.0510	0.6040	6	0.0480	0.5960	6

Figure 1. Research implementation process

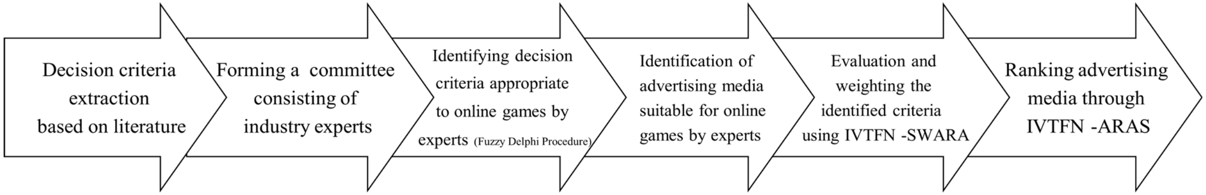

Figure 2. Hierarchical structure of decision-making