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Decision making on business issues with foresight perspective; an application of new hybrid MCDM model in shopping mall locating

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A R T I C L E I N F O

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A B S T R A C T

Shopping malls are one of the glories of metropolises with their attractive shops and a wide variety people who are walking in order to purchase goods. Location of a shopping mall is one of the critical criteria, because it can influence the success of the project. In addition, selecting an appropriate location to establish a new shopping mall is a sophisticated, time consuming and risky decision. Commonly multi-factors should be considered in the decision making model. Thus, a comprehensive model should be considered for similar studies. Moreover, the foresight perspective can be necessary for the future competitiveness of the project. Decision makers need powerful tools for the process of the decision making, for this aim two Multiple Criteria Decision Making (MCDM) methods are applied in our model. Stepwise Weight Assessment Ratio Analysis (SWARA) is applied to decision making in order to prioritize and calculating the relative importance of the criteria. Then, Weighted Aggregated Sum Product Assessment (WASPAS) methodology is used to evaluate potential alternatives. Tehran is considered as a real example of this research and potential places for this mean considered in research. This brand-new hybrid MCDM method is presented in this research as a powerful framework is decision making. This framework can be useful as an appropriate framework for solving locating issues in other companies.

1. Introduction

Modernization has changed our shopping habits from local small autonomous shops to large regional shopping malls. We can find large shopping malls that introduce diverse products (e.g. supermarkets, boutiques, household goods) and services (e.g. banks, cinemas). Also, they can be considered as an excited place (e.g. Disneyland), modern and attractive for alluring consumers. According to Webster dictionary shopping mall describes as follows: collection of independent retail stores, services, and parking areas constructed and maintained by a management firm as a unit. It is a 20th-century adaptation of the historical marketplace. In the U.S., the post-war migration from cities to suburbs and increased automobile use created the perceived need for centralized shopping facilities. The urban shopping arcade was developed out of the need for shelter from the weather; Buffalo, N.Y., and Cleveland, Ohio, have charming trussed and glass-roofed examples. The next generation of shopping malls, the large regional center sited in a vast sea of parking lots, bears little resemblance to its small, arcaded ancestors (Merriam-Webster Online Dictionary, 2013).

Based on studies in this field, the community desires to purchase their requirement from the malls which emphasis on self-actualization and social affiliation values (Shim & Eastlick, 1998). Besides, some papers referred to this matter (Burns & Warren, 1995; Cheng, Li, & Yu 2005).

According to (Cheng, Li, & Yu, 2007) dissatisfaction of people from discount department stores in feature, option, service and updating in contrast with major department stores, shoppers prefers shopping malls, besides high quality of goods and services giving a wide-spreading range of choices and being fashionable are diversity between malls and small or department stores. In addition, construct a huge shopping mall promotes quality of life and develop retail industry (Cheng et al., 2005; Finn & Louviere, 1990).

In recent years, retailing business has been influenced by general and serious changes. Technical extension and market situation have a significant function in affecting retail change that the two

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mentioned factors jointed with almost abundant, extremely changeable and progressively time-scarce consumer (Anderson, Palma, & Thisse 1998; Yu, Yang, & Cheng 2007). Increasing competition between regional malls affected on the design and the renter of shopping malls to captivate both retailers and consumers, due to shoppers attend to aesthetic sensibilities same as their shopping needs (Burns & Warren, 1995; Carlson, 1991).

One of the important factors of shopping malls is location and this factor has the most influence on success in this business. Suitable location is a general term which includes many factors in it to achieve success. For receiving satisfying location some factors should be provided including, accessibility, total cost of initial investment, environmental consideration, potential continuous development, etc. The key decision on shopping mall project investment is the selection of a correct location to progress a right project (Cheng et al. 2005). Also, being profitable or loss of income connected with choosing a suitable selection of trade location. Besides, the accurate selected site can help management to plan essential strategies that can extend market development and rise demands. Appropriate location is able to attract a large number of consumers and a large number of customers can improve profitability. Furthermore, appropriate location has the highest priority for making decisions. Therefore, inappropriate location has negative effects which are so arduous to balance (Craig, Ghosh, & Mclafferty 1984; Jain & Mahajan, 1979; Kuo, Chi, & Kao 2002).

The mall location selection problem is a decision making problem with multiple criteria and with this kind of problem, in conflict criteria play a significant role. Many criteria should be considered in the decision making process such as, population & Economical Characteristics, environmental consideration, attractiveness, accessibility & transportation, etc. Therefore, the shopping mall location problem can be viewed as a multiple criteria decision making problem. But this research has a new perspective to solve this problem. MCDM methods are powerful tools for solving managerial decisions but it seems there is a gap between reality and decision making and that is foresight perspective. There are many important criteria but future is the topic that should be considered.

This research is based on foresight perspective in presenting the best framework based on MCDM methods for decision making about shopping mall location. If investors want to consider important issues about the now and future they should have a flexible tool in their decision making process. Priority should be based on decision makers and for this mean SWARA method is applied for decision making about the priority and the relative importance of the important criteria of this research. WASPAS is the new methodology that developed in 2012 with a high degree of reliability and for this positive advantage WASPAS is applied for evaluating and ranking potential alternatives. Tehran (Iran) is selected as the real example of this research and the rest of the paper is structured as follows:

Section 2 briefly reviews the previously related researches. Section 3 presents the proposed integrated SWARA–WASPAS methodology, and SWARA and WASPAS methods are elaborated as well. The paper follows in Section 4 on a real example study to validate the proposed model. Also, the proposed decision-making SWARA and WASPAS results are presented in Section 4. Finally, some remarks and future research directions are provided in Section 5.

2. Literature review

In the literature review section, we are going to discuss the significance of the mall, location and site selection of mall, from the other researcher's viewpoint. The research on location theory has started nearly a century ago (Weber, 1929). He has minimized the distance between customers and warehouse by selecting a proper warehouse location. Besides, a model has developed as intercity shopping-oriented movements that have considered population circumstances and distance (Reilly, 1931). As the Reilly (1931) model was imperfect, a more basic model has developed which considering customer preferences (Huff, 1964). Over the past decades with proliferation in location selection models, choosing a new site for a retail shop, a facility, or so forth in lots of different projects has been developed (Current, Ratick, & ReVelle 1997; Owen & Daskin, 1998). These models are chiefly mathematical models that can be categorized into two classes: 1. Static and deterministic and 2. Dynamic and stochastic (Owen & Daskin, 1998). The concentration on end user's demeanor was the goal of retailer choice and shopping mall administration internalization (Brown, 1991; Cheng et al. 2005; Roy, 1994; Severin, Louviere, & Finn 2001; Wakefield & Baker, 1998).

Recently, models for selection of a proper location of shopping mall have been changed. These models discuss shoppers would not always choose the mall that is nearest to their lodging, but the elements which important from their standpoint are being attractive and able to support their needs. Dascı and Laporte (2005) proposed a model for choosing a mall from the customer's viewpoint in which some factors have high significance as well. These factors were presented as follows: distance, kind of service and the consumption features. By comparing the three retail shop location selection methods, a research could propose an anticipated-delay method (Kaufmann, Donthu, & Brooks 2000). Evaluation of this method has done by using game-like two-party simulation. Also a model has presented for increasing profit of both the parent company and the trader for selecting a single facility location by (Fernandez, Toth, Plastria, & Pelegrin 2006). They developed a model that solves the facility location selection problem and routing problem in parallel (Nagy & Salhi, 2007). They have studied on negative viewpoint of customers from shopping malls and competitors of them by using Huff's model (Aboolian, Berman, & Krass 2007).

Regarding site selection of mall, some points of views have focused on different things. For example, a study leaded a spatial analysis based on data that gained from shopper behaviors report,

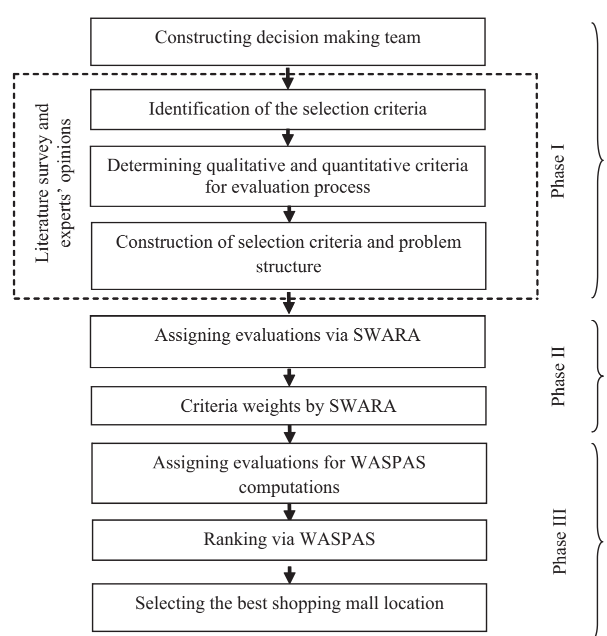

Fig. 1. The evaluation procedure.

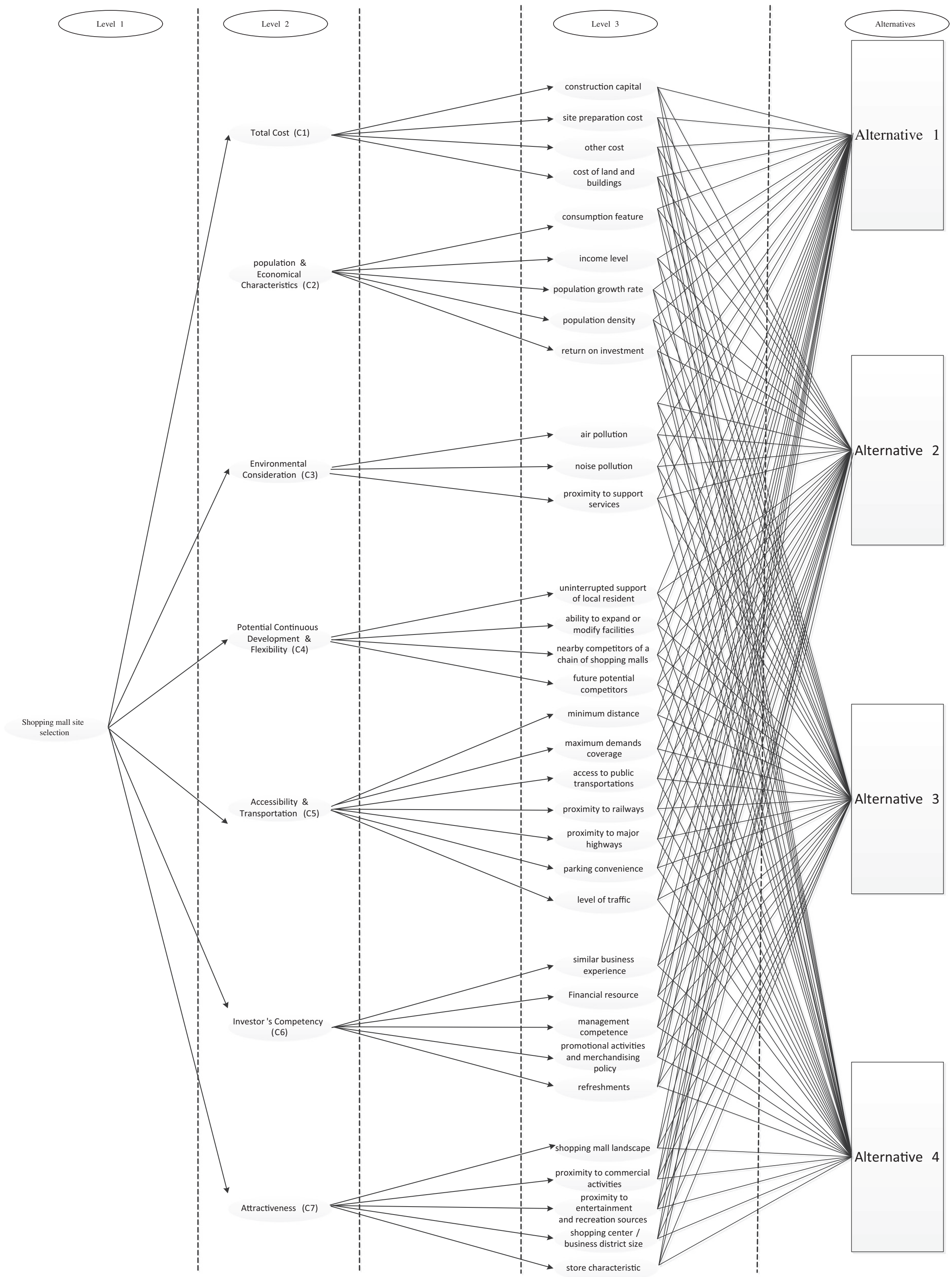

Fig. 2. Problem structure, selection criteria and alternatives.

and ascertained a favorable place in the shopping mall that would be established in Ankara (Bayar, 2005). Bozkaya and Yanık (2008) developed a model in which suggested solutions utilizing a CBS based on decision support system by way of specifying current sites of a chain of shopping malls, location of competitor malls, and potential locations for opening new shopping malls. They also developed a decision support system for evaluating and choosing a proper store site by integration of fuzzy analytic hierarchy process (FAHP) and artificial neural networks (ANN). The criteria that are studied in this paper for evaluating of proper storage location are

Table 1
Factors taken from the review of the related literature which are relevant to the shopping mall location evaluation and selection.

Evaluation Criteria	Sub-Criteria	Preferred	References
Total cost (C1)	C_{1-1}: cost of land and buildings	Min	Cheng et al. (2005), Önüt et al. (2010)
	C_{1-2}: construction capital	Min	
	C_{1-3}: site preparation cost	Min	
	C_{1-4}: other costs	Min	
Population & economical characteristics (C2)	C_{2-1}: consumption feature	Max	Dascı and Laporte (2005); Kuo et al. (2002); Önüt et al. (2010)
	$C_{2.2}$: income level	Max	
	C_{2-3}: population growth rate	Max	
	C_{2-4}: population density	Max	
	C_{2-5}: return on investment	Max	
Environmental consideration (C3)	C_{3-1}: air pollution	Min	Anselmssona (2006), Burnaz and Topcu (2006); Cheng et al. (2005); Kuo et al. (2002); Wakefield and Baker (1998); Önüt et al. (2010)
	C_{3-2}: noise pollution	Min	
	C_{3-3}: proximity to support services	Max	
Potential continuous development & flexibility (C4)	C_{4-1}: uninterrupted support of local resident	Max	Bozkaya and Yanık (2008); Burnaz and Topcu (2006); Cheng et al. (2005); Kuo et al. (2002); Önüt et al. (2010)
	C_{4-2}: ability to expand or modify facilities	Max	
	C_{4-3}: nearby competitors of a chain of shopping malls	Min	
	C_{4-4}: future potential competitors	Max	
Accessibility & transportation (C5)	C_{5-1}: minimum distance	Max	Anselmssona (2006); Burnaz and Topcu (2006); Cheng et al. (2005); Cheng et al. (2007); Dascı and Laporte (2005); Demirela, Demirela, and Kahraman (2010); Hacketta and Foxallb (1994); Kuo et al. (2002); Parsons and Ballantine (2004); Önüt et al. (2010)
	C_{5-2}: maximum demands coverage	Max	
	C_{5-3}: access to public transportations	Max	
	C_{5-4}: proximity to railways	Max	
	C_{5-5}: proximity to major highways	Max	
	C_{5-6}: parking convenience	Max	
	C_{5-7}: level of traffic	Max	
		Min	
Investor's competency (C6)	C_{6-1}: similar business experience	Max	Anselmssona (2006); Cheng et al. (2005)
	C_{6-2}: Financial resource	Max	
	C_{6-3}: management competence	Max	
	C_{6-4}: promotional activities and merchandising policy	Max	
	C_{6-5}: refreshments	Max	
Attractiveness (C7)	C_{7-1}: shopping mall landscape	Max	Ahmed, Ghingold, and Dahari (2007); Burnaz and Topcu (2006); Kuo et al. (2002); Önden, Şen, and Şen (2012); Önüt et al. (2010)
	C_{7-2}: proximity to commercial activities	Max	
	C_{7-3}: proximity to entertainmentand recreation sources	Max	
	C_{7-4}: shopping center/ business district size	Max	
	C_{7-5}: store characteristic	Max	

determined as competition, convenience and economic stability, population characteristics, store characteristic, availability, magnet (Kuo et al., 2002). They investigated how can select a proper location for new branches of a house ware and hardware store chain (Cook & Green, 2003). This paper examined the old models of store location and has expressed these models by some mathematical and methodological problems (Nwogugu, 2006). He also believed that behavioral elements, for example site-specific, and distance in un-warranted and retailer-specific characteristics are undoubtedly excluded in these models. Cheng et al. (2007) utilized geographic information systems for determination of shopping mall site selection. Yu et al. (2007) obtained the satisfactory of supplier and customers via optimizing the distribution of shopping malls. They used parallel genetic algorithm for comprehending the shortest car based shopping travels in a metropolitan area.

Finally, we have discussed the papers in which multiple criteria decision making (MCDM) approach for site selection of mall have been applied. They proposed a model that utilizes analytic network process (ANP) to choose the suitable location for a shopping mall. Besides, they recognized seven main criteria and twenty-four sub-criteria for selecting a mall location (Cheng et al. 2005). Önüt, Efendigil, and Kara (2010) combined fuzzy AHP and fuzzy TOPSIS to select the best site for a shopping mall. The criteria affecting mall location evaluation in this paper are identified as population characteristics, environmental considerations, degree of competition, accessibility, economy, total cost, flexibility and attractiveness. Accessibility is the key of success for a mall, besides a mall should include the welfare and comfort for shoppers (Önüt et al. 2010). One of the hottest points of this business is site selection for every shopping mall. Not only good outlook and accessibility have significant effects on site selection even competition, demographics and market demands are also needed. According to the mentioned researches from a literature review of retail business and have an introduction section, selecting a good location is one of the important factors for building a shopping mall.

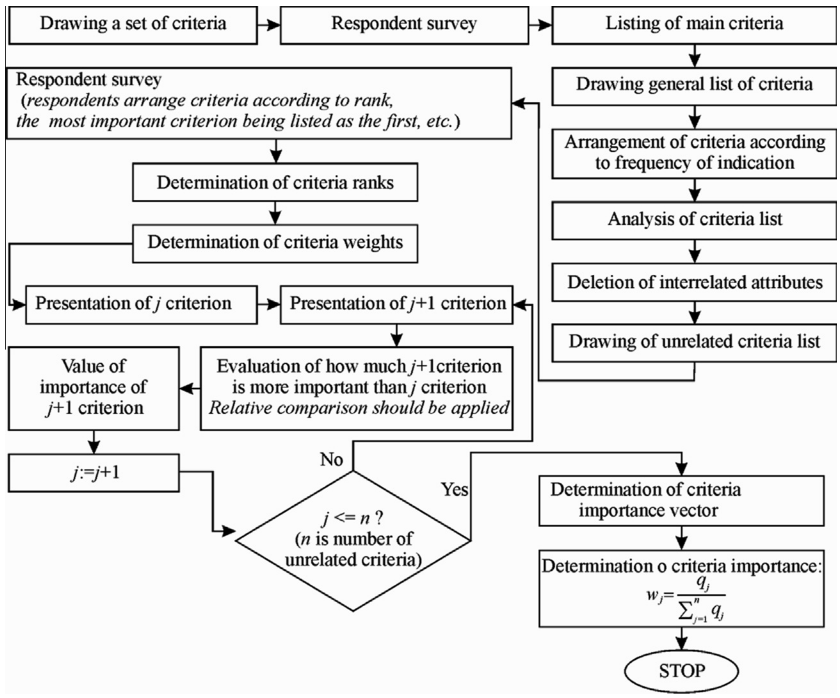

Fig. 3. Determining of the criteria weights based on (Keršulienė & Turskis, 2011).

Table 2
identified Alternatives and Description of their locations.

Alternatives	Location
A_1: Lavasan	Southwest side of intersection of Imam Khomeini boulevard and Saheli, Lavasan,
A_2: Farahzad	Near the gas station in Argahavan, Yadegar Emam Highway
A_3: Imam Hossein Square	Hefdah Shahrivar Boulevard close to Imam Hossein Square
A_4: ShahrakTakhti	East side of Shahrak Takhti, Azadegan Expy
A_5: Chitgar Lake	Northeast side of Chitgar Lake

Fig. 4.1. Lavasan.

Fig. 4.2. Farahzad.

Fig. 4.3. Imam Hossein square.

3. The proposed integrated SWARA–WASPAS methodology

This proposed hybrid MCDM model is a novel integrated approach which is presented in this paper. The MCDM methods deal with the process of making decisions in finding the most suitable alternative (optimum alternative) in the presence of multiple, usually conflicting, decision criteria (Aghdaie, Hashemkhani Zolfani, & Zavadskas, 2013b).

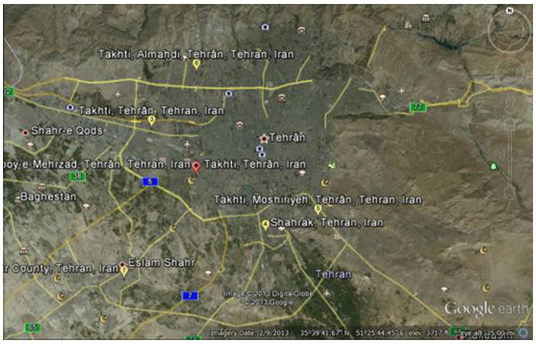

Fig. 4.4. Shahrak Takhti.

Fig. 4.5. Chitgar Lake.

Table 3
Background information of experts.

Category	Classification	No.
Working in background	Civil engineer	3
	Economic expert	2
	Future studies expert	1
	Municipal affaire expert	1
	Marketing expert	1
Education Level	Bachelor	0
	Master	5
	Ph.D.	3
Sex	Male	7
	Female	1

Shopping mall location can be considered as a multiple criteria decision-making problem (MCDM) which encompasses both qualitative and quantitative multiple factors. Both SWARA and WASPAS are new MCDM methods that have been developed recently, SWARA in 2010 and WASPAS in 2012. In this research SWARA was used to evaluate and calculate the relative importance of each criterion and WASPAS was applied to assess identified alternatives related to the topic of selecting a location for establishing a new shopping mall. Fig. 1 describes the evaluation procedure of this study which consists of three main phases:

Phase I. After constructing a decision making team, the most important criteria for shopping mall selection is identified. Next, the qualitative and quantitative criteria are defined. Finally, the project team constructs the selection criteria and problem structure. Fig. 2 represents the selection criteria and problem structure. As depicted in Fig. 2, on the second level, there are seven criteria that are decomposed into numerous sub-criteria. The proposed criteria related to the shopping mall selection problem are presented in Table 1.

Phase II. Criteria weights were calculated by applying SWARA method and based on experts ‘evaluations.

Phase III. In this stage, all alternatives were evaluated by project team and WASPAS method was applied to achieve the final ranking results.

Table 4
Final results of SWARA method in weight assessment criteria.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$
C_5		1	1	0.216
C_2	0.175	1.175	0.852	0.184
C_1	0.1375	1.1375	0.75	0.162
C_4	0.182	1.182	0.635	0.136
C_7	0.194	1.194	0.532	0.114
C_6	0.143	1.143	0.466	0.100
C_3	0.15	1.15	0.406	0.088

Table 5
Final results of SWARA method in weighting criteria of total cost.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
C_{1-1}		1	1	0.334	0.055
C_{1-2}	0.2625	1.2625	0.793	0.264	0.042
C_{1-3}	0.169	1.169	0.679	0.226	0.037
C_{1-4}	0.282	1.282	0.53	0.176	0.028

Table 6
Final results of SWARA method in weighting criteria of population and economical characteristics.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
C_{2-4}		1	1	0.267	0.05
C_{2-5}	0.15	1.15	0.87	0.233	0.042
C_{2-2}	0.169	1.169	0.745	0.198	0.036
C_{2-3}	0.2375	1.2375	0.603	0.161	0.03
C_{2-1}	0.143	1.143	0.528	0.141	0.026

Table 7
Final results of SWARA method in weighting criteria of environmental consideration.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
C_{3-3}		1	1	0.390	0.034
C_{3-2}	0.2	1.2	0.834	0.326	0.029
C_{3-1}	0.15	1.15	0.725	0.284	0.025

Table 8
Final results of SWARA method in weighting criteria of potential continuous development and flexibility.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
C_{4-2}		1	1	0.332	0.046
C_{4-4}	0.256	1.256	0.797	0.265	0.036
C_{4-3}	0.2	1.2	0.665	0.221	0.03
C_{4-1}	0.212	1.212	0.549	0.182	0.024

Table 9
Final results of SWARA method in weighting criteria of accessibility and transportation.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
$C_{5\text{-}3}$		1	1	0.215	0.047
$C_{5\text{-}5}$	0.132	1.132	0.884	0.190	0.042
$C_{5\text{-}6}$	0.15	1.15	0.769	0.164	0.036
$C_{5\text{-}7}$	0.175	1.175	0.655	0.141	0.03
$C_{5\text{-}2}$	0.212	1.212	0.541	0.116	0.025
$C_{5\text{-}1}$	0.206	1.206	0.449	0.096	0.02
$C_{5\text{-}4}$	0.232	1.232	0.365	0.078	0.016

Table 10
Final results of SWARA method in weighting criteria of investor's competency.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
$C_{6\text{-}3}$		1	1	0.272	0.0272
$C_{6\text{-}2}$	0.1875	1.1875	0.843	0.230	0.023
$C_{6\text{-}4}$	0.175	1.175	0.718	0.196	0.0196
$C_{6\text{-}1}$	0.194	1.194	0.602	0.164	0.0164
$C_{6\text{-}5}$	0.182	1.182	0.51	0.138	0.0138

Table 11
Final results of SWARA method in weighting criteria of attractiveness.

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$	Final weights
$C_{7\text{-}1}$		1	1	0.265	0.03
$C_{7\text{-}3}$	0.125	1.125	0.889	0.236	0.027
$C_{7\text{-}4}$	0.2	1.2	0.741	0.196	0.023
$C_{7\text{-}2}$	0.1875	1.1875	0.624	0.165	0.018
$C_{7\text{-}5}$	0.206	1.206	0.518	0.138	0.016

Table 12
The weights of sub-criteria of the model.

Criteria and sub-criteria	Final weights
C1: Total cost	0.162
$C_{1\text{-}1}$: Cost of land and buildings	0.055
$C_{1\text{-}2}$: Construction capital	0.042
$C_{1\text{-}3}$: Site preparation cost	0.037
$C_{1\text{-}4}$: Other costs	0.028
C2: Population & economical characteristics	0.184
$C_{2\text{-}1}$: Consumption feature	0.026
$C_{2.2}$: Income level	0.036
$C_{2\text{-}3}$: Population growth rate	0.03
$C_{2\text{-}4}$: Population density	0.05
$C_{2\text{-}5}$: Return on investment	0.042
C3: Environmental consideration	0.088
$C_{3\text{-}1}$: Air pollution	0.025
$C_{3\text{-}2}$: Noise pollution	0.029
$C_{3\text{-}3}$: Proximity to support services	0.034
C4: Potential continuous development & flexibility	0.136
$C_{4\text{-}1}$: Uninterrupted support of local resident	0.024
$C_{4\text{-}2}$: Ability to expand or modify facilities	0.046
$C_{4\text{-}3}$: Nearby competitors of a chain of shopping malls	0.03
$C_{4\text{-}4}$: Future potential competitors	0.036
C5: Accessibility & transportation	0.216
$C_{5\text{-}1}$: Minimum distance	0.02
$C_{5\text{-}2}$: Maximum demands coverage	0.025
$C_{5\text{-}3}$: Access to public transportations	0.047
$C_{5\text{-}4}$: Proximity to railways	0.016
$C_{5\text{-}5}$: Proximity to major highways	0.042
$C_{5\text{-}6}$: Parking convenience	0.036
$C_{5\text{-}7}$: Level of traffic	0.03
C6: Investor's competency	0.100
$C_{6\text{-}1}$: Similar business experience	0.0164
$C_{6\text{-}2}$: Financial resource	0.023
$C_{6\text{-}3}$: Management competence	0.0272
$C_{6\text{-}4}$: Promotional activities and merchandising policy	0.0196
$C_{6\text{-}5}$: Refreshments	0.0138
C7: Attractiveness	0.114
$C_{7\text{-}1}$: Shopping mall landscape	0.03
$C_{7\text{-}2}$: Proximity to commercial activities	0.018
$C_{7\text{-}3}$: Proximity to entertainment and recreation sources	0.027
$C_{7\text{-}4}$: Shopping center/business district size	0.023
$C_{7\text{-}5}$: Store characteristic	0.016

3.1. Step-wise weight assessment ratio analysis (SWARA) method

In this method, expert has an important role in evaluations and calculating weights. Also, each expert has chosen the importance of each criterion. Next, each expert ranks all the criteria from the first to the last one. An expert uses his or her own implicit knowledge, information and experiences. Based on this method, the most significant criterion is given rank 1, and the least significant criterion is given rank last. The overall ranks of the group of experts are determined according to the mediocre value of ranks (Keršulienė & Turskis, 2011).

The ability to estimate experts' opinion about importance ratio of the criteria in the process of their weight determination is the main element of this method (Keršulienė, Zavadskas, & Turskis, 2010). Moreover, this method is helpful for coordinating and gathering data from experts. Furthermore, SWARA method is uncomplicated and experts can easily work together. The main advantage of this method in decision making is that on some problems priorities are defined based on policies of companies or countries and there are not any needs for evaluation to rank criteria.

In other methods like AHP or ANP, our model is created based on criteria and experts' evaluations will affect priorities and ranks. So, SWARA can be useful for some issues that priorities are known former according to situations and finally SWARA proposed for applying in certain environments of decision making. The all developments of decision making models based on SWARA method up to now are listed below:

- Keršulienė et al. (2010) in selection of rational dispute resolution method.
- Keršulienė and Turskis (2011) for architect selection.
- Hashemkhani Zolfani, Zavadskas, Turskis, local perspectives based on Yin-Yang balance theory, and Economic Research (2013a) in design of products.
- Hashemkhani Zolfani, Esfahani, Bitarafan, Zavadskas, and Lale Arefi (2013b) in selecting the optimal alternative of mechanical longitudinal ventilation of tunnel pollutants.
- Hashemkhani Zolfani, Farrokhzad, Turskis, and E&M Economics and Management (2013c). Investigating on the success factors of online games based on explorer.
- Aghdaie, Hashemkhani Zolfani, and Zavadskas (2013a) in the machine tool selection.

3.2. Weighted aggregates sum product assessment (WASPAS)

This new method presented lately and is known as one of the newest methods proposed by Scientifics. This new methodology is based on Weighted Sum Model (WSM) and Weighted Product

Table 13
Decision making matrix.

	C_{1-1}	C_{1-2}	C_{1-3}	C_{1-4}	C_{2-1}	C_{2-2}	C_{2-3}	C_{2-4}	C_{2-5}	C_{3-1}	C_{3-2}	C_{3-3}	C_{4-1}	C_{4-2}	C_{4-3}	C_{4-4}	C_{5-1}
q	0.055	0.042	0.037	0.028	0.026	0.036	0.03	0.05	0.042	0.025	0.029	0.034	0.024	0.046	0.03	0.036	0.02
	Min	Min	Min	Min	Max	Max	Max	Max	Max	Min	Min	Max	Max	Max	Min	Max	Max
A_1	5	7	5	5	6	7	5	4	5	2	2	3	3	6	2	7	4
A_2	7	7	6	5	7	7	6	6	6	4	4	5	5	8	5	7	6
A_3	6	7	6	5	6	5	4	8	6	7	7	7	6	6	5	6	7
A_4	5	7	5	5	5	4	4	7	4	6	7	6	5	5	4	5	6
A_5	4	7	5	5	6	6	7	5	4	3	3	3	5	7	7	8	6

	C_{5-2}	C_{5-3}	C_{5-4}	C_{5-5}	C_{5-6}	C_{5-7}	C_{6-1}	C_{6-2}	C_{6-3}	C_{6-4}	C_{6-5}	C_{7-1}	C_{7-2}	C_{7-3}	C_{7-4}	C_{7-5}
q	0.025	0.047	0.016	0.042	0.036	0.03	0.0164	0.023	0.0272	0.0196	0.0138	0.03	0.018	0.027	0.023	0.016
	Max	Max	Max	Max	Max	Min	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max
A_1	4	2	3	4	7	2	6	7	6	7	5	5	2	5	4	4
A_2	7	5	4	6	5	6	6	7	6	7	5	6	4	6	6	6
A_3	8	8	8	7	3	8	6	7	6	7	5	6	5	4	6	5
A_4	6	7	6	5	3	7	6	7	6	7	5	6	6	4	5	6
A_5	6	2	3	5	7	3	6	7	6	7	5	8	3	8	6	5

Table 14
WASPAS normalized decision making matrix.

	C_{1-1}	C_{1-2}	C_{1-3}	C_{1-4}	C_{2-1}	C_{2-2}	C_{2-3}	C_{2-4}	C_{2-5}	C_{3-1}	C_{3-2}	C_{3-3}	C_{4-1}	C_{4-2}	C_{4-3}	C_{4-4}	C_{5-1}
q	0.055	0.042	0.037	0.028	0.026	0.036	0.03	0.05	0.042	0.025	0.029	0.034	0.024	0.046	0.03	0.036	0.02
	Min	Min	Min	Min	Max	Max	Max	Max	Max	Min	Min	Max	Max	Max	Min	Max	Max
A_1	0.8	1	1	1	0.86	1	0.72	0.5	0.84	1	1	0.43	0.5	0.75	1	0.88	0.58
A_2	0.58	1	0.84	1	1	1	0.86	0.75	1	0.5	0.5	0.72	0.84	1	0.4	0.88	0.86
A_3	0.67	1	0.84	1	0.86	0.72	0.58	1	1	0.29	0.29	1	1	0.75	0.4	0.75	1
A_4	0.8	1	1	1	0.72	0.58	0.58	0.88	0.67	0.34	0.29	0.86	0.84	0.63	0.5	0.63	0.86
A_5	1	1	1	1	0.86	0.86	1	0.63	0.67	0.67	0.67	0.43	0.84	0.88	0.29	1	0.86

	C_{5-2}	C_{5-3}	C_{5-4}	C_{5-5}	C_{5-6}	C_{5-7}	C_{6-1}	C_{6-2}	C_{6-3}	C_{6-4}	C_{6-5}	C_{7-1}	C_{7-2}	C_{7-3}	C_{7-4}	C_{7-5}
q	0.025	0.047	0.016	0.042	0.036	0.03	0.0164	0.023	0.0272	0.0196	0.0138	0.03	0.018	0.027	0.023	0.016
	Max	Max	Max	Max	Max	Min	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max
A_1	0.5	0.25	0.38	0.58	1	1	1	1	1	1	1	0.63	0.34	0.63	0.67	0.67
A_2	0.88	0.63	0.5	0.86	0.72	0.34	1	1	1	1	1	0.75	0.67	0.75	1	1
A_3	1	1	1	1	0.43	0.25	1	1	1	1	1	0.75	0.84	0.5	1	0.84
A_4	0.75	0.88	0.75	0.72	0.43	0.29	1	1	1	1	1	0.75	1	0.5	0.84	1
A_5	0.75	0.25	0.38	0.72	1	0.67	1	1	1	1	1	1	0.5	1	1	0.84

Table 15
WASPAS weighted and normalized decision making matrix for summarizing part.

	C_{1-1}	C_{1-2}	C_{1-3}	C_{1-4}	C_{2-1}	C_{2-2}	C_{2-3}	C_{2-4}	C_{2-5}	C_{3-1}	C_{3-2}	C_{3-3}	C_{4-1}	C_{4-2}	C_{4-3}	C_{4-4}	C_{5-1}
A_1	0.044	0.042	0.037	0.028	0.022	0.036	0.022	0.025	0.035	0.025	0.029	0.015	0.012	0.035	0.030	0.032	0.012
A_2	0.032	0.042	0.031	0.028	0.026	0.036	0.026	0.038	0.042	0.013	0.015	0.024	0.020	0.046	0.012	0.032	0.017
A_3	0.037	0.042	0.031	0.028	0.022	0.026	0.017	0.050	0.042	0.007	0.008	0.034	0.024	0.035	0.012	0.027	0.020
A_4	0.044	0.042	0.037	0.028	0.019	0.021	0.017	0.044	0.028	0.009	0.008	0.029	0.020	0.029	0.015	0.023	0.017
A_5	0.055	0.042	0.037	0.028	0.022	0.031	0.030	0.032	0.028	0.017	0.019	0.015	0.020	0.040	0.009	0.036	0.017

	C_{5-2}	C_{5-3}	C_{5-4}	C_{5-5}	C_{5-6}	C_{5-7}	C_{6-1}	C_{6-2}	C_{6-3}	C_{6-4}	C_{6-5}	C_{7-1}	C_{7-2}	C_{7-3}	C_{7-4}	C_{7-5}
A_1	0.013	0.012	0.006	0.024	0.036	0.030	0.016	0.023	0.027	0.020	0.014	0.019	0.006	0.017	0.015	0.011
A_2	0.022	0.030	0.008	0.036	0.026	0.010	0.016	0.023	0.027	0.020	0.014	0.023	0.012	0.020	0.023	0.016
A_3	0.025	0.047	0.016	0.042	0.015	0.008	0.016	0.023	0.027	0.020	0.014	0.023	0.015	0.014	0.023	0.013
A_4	0.019	0.041	0.012	0.030	0.015	0.009	0.016	0.023	0.027	0.020	0.014	0.023	0.018	0.014	0.019	0.016
A_5	0.019	0.012	0.006	0.030	0.036	0.020	0.016	0.023	0.027	0.020	0.014	0.030	0.009	0.027	0.023	0.013

Model (WPM). Zavadskas, Turskis, Antucheviciene, and Zakarevicius (2012) are the innovators of this new method and they proved that accuracy of this aggregated methods is better in comparing to accuracy of one of them.

WASPAS calculation is based on these steps:

3.2.1. Normalized decision making matrix if opt value is max based on

$$\bar{x}_{ij} = \frac{x_{ij}}{\underset{i}{opt}\, x_{ij}}, \text{ where } i = \overline{1,m}; j = \overline{1,n} \tag{1}$$

if opt value is min

$$\bar{x}_{ij} = \frac{\underset{i}{opt}\, x_{ij}}{x_{ij}}, \text{ where } i = \overline{1,m}; j = \overline{1,n} \tag{2}$$

3.2.2. Calculating WASPAS weighted and normalized decision making matrix for summarizing part

$$\bar{\bar{x}}_{ij,sum} = \bar{x}_{ij}^{q_j}, \text{ where } i = \overline{1,m}; j = \overline{1,n} \tag{3}$$

Table 16
WASPAS weighted and normalized decision making matrix for multiplication part.

	C_{1-1}	C_{1-2}	C_{1-3}	C_{1-4}	C_{2-1}	C_{2-2}	C_{2-3}	C_{2-4}	C_{2-5}	C_{3-1}	C_{3-2}	C_{3-3}	C_{4-1}	C_{4-2}	C_{4-3}	C_{4-4}	C_{5-1}
A_1	0.988	1.000	1.000	1.000	0.996	1.000	0.990	0.966	0.993	1.000	1.000	0.972	0.984	0.987	1.000	0.995	0.989
A_2	0.970	1.000	0.994	1.000	1.000	1.000	0.995	0.986	1.000	0.983	0.980	0.989	0.996	1.000	0.973	0.995	0.997
A_3	0.978	1.000	0.994	1.000	0.996	0.988	0.984	1.000	1.000	0.970	0.965	1.000	1.000	0.987	0.973	0.990	1.000
A_4	0.988	1.000	1.000	1.000	0.991	0.981	0.984	0.994	0.983	0.973	0.965	0.995	0.996	0.979	0.979	0.984	0.997
A_5	1.000	1.000	1.000	1.000	0.996	0.995	1.000	0.977	0.983	0.990	0.988	0.972	0.996	0.994	0.964	1.000	0.997

	C_{5-2}	C_{5-3}	C_{5-4}	C_{5-5}	C_{5-6}	C_{5-7}	C_{6-1}	C_{6-2}	C_{6-3}	C_{6-4}	C_{6-5}	C_{7-1}	C_{7-2}	C_{7-3}	C_{7-4}	C_{7-5}
A_1	0.983	0.937	0.985	0.977	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.986	0.981	0.988	0.991	0.994
A_2	0.997	0.979	0.989	0.994	0.988	0.968	1.000	1.000	1.000	1.000	1.000	0.991	0.993	0.992	1.000	1.000
A_3	1.000	1.000	1.000	1.000	0.970	0.959	1.000	1.000	1.000	1.000	1.000	0.991	0.997	0.981	1.000	0.997
A_4	0.993	0.994	0.995	0.986	0.970	0.964	1.000	1.000	1.000	1.000	1.000	0.991	1.000	0.981	0.996	1.000
A_5	0.993	0.937	0.985	0.986	1.000	0.988	1.000	1.000	1.000	1.000	1.000	1.000	0.988	1.000	1.000	0.997

Table 17
The results of WASPAS.

	$0.5\sum_{j=1}^{N}\bar{\bar{x}}_{ij}$	$0.5\prod_{j=1}^{n}\bar{\bar{x}}_{ij}$	**WSP_i**	**Ranking**
A_1	0.385	0.3615	0.7465	4
A_2	0.403	0.3881	0.7911	1
A_3	0.4015	0.3764	0.7779	3
A_4	0.373	0.3543	0.7273	5
A_5	0.4015	0.3783	0.7798	2

3.2.3. Calculating WASPAS weighted and normalized decision making matrix for multiplication part

$$\bar{\bar{x}}_{ij,mult} = \bar{x}_{ij}^{q_j}, \text{ where } i = \overline{1,m}; j = \overline{1,n} \quad (4)$$

3.2.4. Final calculating for evaluating and prioritizing alternatives based on

$$WPS_i = 0.5\sum_{j=1}^{n}\bar{\bar{x}}_{ij} + 0.5\prod_{j=1}^{n}\bar{\bar{x}}_{ij}, \text{ where } i = \overline{1,m}; j = \overline{1,n} \quad (5)$$

The all researchers based on the WASPAS method up to now are listed below:

– Zavadskas et al. (2012) developing WASPAS as a new methodology.
– Staniunas, Medineckiene, Zavadskas, and Kalibatas (2013) in the Ecological – economical assessment of multi-dwelling houses modernization.

4. Real example

Without case study or real example the applicability of a new approach is not clear. Thus, in this paper, we considered a real example to show our applicability of our approach. Iranian's society is changing fast and transforms in many aspects, including business structures, people's free time, jobs, transportation systems, shopping and customers. In addition, the population of cities increase every year and more and more people migrate to the big cities to find more opportunities. All of these features can create new needs for customers including, looking for low prices, purchasing all products from one place in a short time and parking facilities. Therefore, these factors are able to boost customers' interest in constructing the new shopping malls in the big cities.

In feasibility studies one of the critical factors that identify whether the project should be undertaken or not is located. Location criterion is very important, especially in shopping malls' projects (Önüt et al., 2010). Finally five potential locations denoted as A_1, A_2, A_3, A_4 and A_5, respectively. More information about alternatives is explained in Table 2.

Besides, potential locations are illustrated in Figs. 4.1–4.5. Among all identified criteria some them are cost criterion (the minimum amount of this criterion is desirable) and others are benefitted criteria. The third column of Table 1 shows kind of criterion according to prefer of them. For instance, C_{3-1} (air pollution) is minimum preferred factor. This kind of classification is important for WASPAS analysis.

Decision making team has followed every step of this project for this selection. They had accepted criteria list for evaluation of alternatives which is derived from the literature survey. Also, they developed the problem structure (see Fig. 2).

For receiving consensus in every step of this project Delphi method were used. Delphi is a very famous method for receiving general agreement in complicated decision making situations (Aghdaie et al. 2013a). Therefore, after a lot of discussions, a project team identified criteria for evaluation and they constructed problem structure. Then the project team accepted the criteria list that was explored from the literature study (see Table 2). There was a general consensus about this criteria list. As mentioned before, in this paper SWARA was used for calculating criteria weights.

4.1. Experts' information

Similar to other MADM methods, experts are one of the decisive factors that can enhance the quality of the MADM results. Experts' judgments with bias are incapable of providing good judgments output. Thus, we tried to cooperate with the best qualified experts.

In this study experts participated in two parts. Firstly, in criteria selection, possible alternatives and model design.

Secondly, they cooperate together in the evaluation process via SWARA and WASPAS techniques. Experts participated in evaluate and prioritize of alternatives based on SWARA and WASPAS.

The information about experts is shown in Table 3. An average age of experts is 39 with an average of 15 years experience in their specific fields. Eight experts have participated in this paper.

5. SWARA results

In this section of the paper, we focus on obtained SWARA results that was calculated based on SWARA approach. SWARA method was used to as an MCDM tool by the experts' group to reach consensus. As mentioned before, for selecting an appropriate shopping mall location a thorough survey of the literature was conducted in order to gather useful and suitable factors and information. Tables 4–11 shows the results of criteria weights for all assessment criteria, criteria and sub-criteria. The rank of criteria is shown in the first column and the last column is shown the weight of each criterion. Fig. 3 is used to calculate the weight of each criterion according to experts' evaluations for all criteria.

In order to show more comfortable, the combination of all Tables 4–11 is depicted in Table 12.This table, shows the weights of all criteria and sub-criteria which are needed to be utilized by WASPAS method.

6. WASPAS results

In this section of the paper, after calculating SWARA results, we ranked locations based on WASPAS technique. Eqs. (1)–(5) were used for calculating in WASPAS method (see WASPAS steps in Section 3.2). We had five alternatives in this paper and they were five potential shopping mall locations as alternatives for evaluating process. The alternatives were denoted as A_1, A_2, A_3, A_4, and A_5. Eight decision-making experts evaluated each alternative and gave a score to every one of them. For receiving general agreement, Delphi method was applied. Table 13 shows the decision matrix which is filled by experts.

After creating decision matrix, Equation (1) was used for the calculation of the normalized value (see WASPAS steps) and other steps were followed to receive the final ranking. Table 14 shows the WASPAS normalized decision making matrix. WASPAS weighted and normalized decision making matrix for summarizing part is calculated by using Eq. (3) (see Table 15) and Eq. (4) was used Calculating WASPAS weighted and normalized decision making matrix for multiplication part (see Table 16).

Finally, Eq. (5) was applied for final ranking of alternatives. Table 17 shows results of WASPAS methodology. According to Table 17 which shows the ultimate results of WASPAS methodology, Alternative 2 (Farahzad) is the best option for this selection. Based on this table this location can be the best possible place for a new shopping mall. Also, the proposed hybrid model provides a systemically analytic model for location selecting problems.

7. Conclusion and future research directions

As we all know, locating is an important issue in business matters. Selecting the strategic places for business is so important and can develop business in various dimensions. Shopping malls have a symbolic role in metropolises although their role probably will develop in the future. Metropolises in developing countries like Tehran are aimed to develop infrastructures in themselves but planning in these crowded cities with different levels of income is so difficult and there is not any stable model for decision making in them.

This research presents a new model based on new hybrid MCDM methods. Selection of the methodology is based on a logical perspective. The authors believe that decision making about this important issue should be based on a foresight perspective. Establishing a shopping mall is very expensive for investors in both governmental and private levels. Selecting an appropriate place for establishing a shopping mall is a critical issue in business. Moreover it seems that this issue needs a method that makes a suitable environment for decision making due to foresight perspective. SWARA is a suitable method for this mean because experts can freely think and make their decisions. It does not seem that criteria singly can do anything in issues with foresight perspectives. Finally research needs a powerful method for evaluating and ranking alternatives. WASPAS is a new methodology with high efficiency and effectiveness in the process of decision making and the authors proposed this method for joining to the process of decision making in this research.

The integrated proposed methodology can be used as an analytical model for dealing with individual challenges in conflict management situations. Therefore further research can apply this combined methodology as an adaptable approach to other situations. In addition, a new study could focus on using other MCDM techniques including ARAS, ANP, and PROMETHEE, etc. and compare that with the results of this paper.

This study's results show that decision criteria significantly influence the choice of shopping mall location. However in this paper the most important criteria were selected based on the in-depth literature survey; another study can design a new structure with other criteria, sub-criteria and assess alternatives using a new structure.

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