
Logistics specialist selection with intuitionistic fuzzy TOPSIS method

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Abstract: In a globally competitive environment, businesses, regardless of size, scale and industry, have to develop a base on their human capital to ensure their survival, sustainable competitive advantage and superior performance. Therefore, this study aims to propose an approach to the personnel selection (PS) problem in a highly unstable industry of logistics in an emerging market, with a real case and in a group decision-making environment. Intuitionistic fuzzy (IF) TOPSIS method with a set of six criteria developed by a group of eight experts and evaluated by three managers in different levels of a logistics business, has been applied to six candidates to fulfil a vacant position of ‘logistics specialist’. It concludes that ‘communication/negotiation skills’, ‘analytical thinking’, ‘graduation’, ‘professional experience’, ‘teamwork’, ‘computer literacy’, and ‘fluency in foreign language(s)’ are the criteria to be employed as a ‘logistics specialist’ with respect to their relative weights. Based on such criteria, the candidates are ranked respectively and the most appropriate one is recommended for employment.

Keywords: personnel selection; logistics specialist; intuitionistic fuzzy; TOPSIS; MCDM.

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1 Introduction

In a new complex and uncertain competitive landscape characterised with new forms of global competition, substantial, often frame-breaking, continuous unpredictable change, rapid developments in technology, higher speed in decision-making processes and shorter product-life cycles (Dreyer and Grønhaug, 2004; Hitt et al., 2002; Erdem, 2016; Stanujkic et al., 2015) businesses need to perform strategic entrepreneurial actions (i.e., simultaneous opportunity- and advantage-seeking behaviours) to ensure their survival, to create sustainable competitive advantages and to generate superior performance in the long run with an entrepreneurial mindset [Ireland and Webb, 2007; Ketchen et al., 2007; Ulgen and Mirze, (2010), p.34; Ireland et al., 2003; Hitt et al., 2011; Kraus et al., 2011] through something new or improved raw materials, products/services, processes, managerial techniques and technologies or combination of aforementioned (Altuntas et al., 2016). With this perspective, either a competitive advantage (i.e., a result of valuable, rare, inimitable and non-substitutable internal resources and/or capabilities) (Barney, 1991) through the RBV (resource-based view) lens or an innovation (Ireland et al., 2003; Smith and Tushman, 2005) requires a business – to ensure the success in terms of performance with lowering costs or differentiating – to establish a base on its human capital (Dahooie et al., 2018; Barney, 2002; McGrath and MacMillan, 2000), which is defined as the accumulation of various knowledge, skills, and abilities gained through education, experience, and training (Shoubaki et al., 2019) of employees within an organisation since it is very hard for a competitor to duplicate such key elements (Chahal and Bakshi, 2015).

Human resources management (HRM) function in any kind of organisation, based on such a view, is mainly concerned with the activities of attraction, development, motivation, retention of a workforce with high performance, which is highly correlated to organisational success (Sims, 2002). With this view, businesses are expected to develop some practices aligned with their business- and corporate-level strategies [Ulgen and Mirze, (2010), p.291] to attract (Aggarwal, 2013), to select and to recruit the right person for the right job as an essential and major HRM subroutine (Dahooie et al., 2018), – particularly in an economy regarded as ‘knowledge’ with rising unemployment rates (Celikbilek, 2018) – since people make a difference (Afsar et al., 2015) in terms of positive outcomes such as a competitive advantage (Bali et al., 2013; Dahooie et al., 2018) or an innovation (Samanlioglu et al., 2018) in case of a good person-job fit indicating that the required job characteristics are quite aligned with an employee’s knowledge, skills, abilities, and preferences (Tims et al., 2016). In addition, it should be noted as well that it costs a lot to take back a wrongful decision made to hire a poor or a disappointing performer (Liao and Chang, 2009) due to the direct costs of the time spent on and those associated (Golec and Kahya, 2007) with engaging, training, monitoring, and firing that person (Afshari et al., 2014; Kasraee and Etemadi, 2018) and unnecessary financial and time-related losses of employing a new one [Kenger and Organ, (2017), p.166] as well as the indirect costs of loss in productivity, precision flexibility, quality of the product (Dagdeviren, 2010) and industrial accidents (Kusakci et al., 2019) in an organisation, which contributes the crucial role personnel selection (PS) process plays in business failures (Kasraee and Etemadi, 2018).

PS, as expected, has become a major concern of logistics, too, – since all is done for people by people and provides a major revenue stream of national economy as well as a trigger to national competitiveness (Sezer and Abasiz, 2017) – which requires businesses to meet a gradually growing need of professionals (Thai, 2012) with special knowledge and talent (Shou et al., 2017) of more than 280 skills (Kotzab et al., 2018) due to a complex, multidimensional, integrated and international structure with different decision levels (Avelar-Sosa et al., 2020; Caylan and Yildiz, 2016) regardless of size and scale of a business and mode used in transportation or the country. Based on such paradigm, logistics is of particular interest in this study with a representation from Turkey – classified as an emerging economy –, who is likely to become an international logistics centre and improve its position in logistics performance index by 2023 (Ozcan et al., 2018). It is also one of the fiercest competitive industries (ISTKA, 2019) of Turkey with a prediction of new entries in terms of foreign direct investments by 2023 (Ozcan et al., 2018). Moreover, it accounts for US\$6,5 billion of worth of goods and services, 400k workers of employment (ISTKA, 2019) and 12% of gross national product (GNP) [TIM, (2019), p60] with an industrial employee turnover rate of more than 22% (PerYön, 2018) in addition to a lack of qualified manpower (Erkan, 2014; Industrial Report of Transportation and Logistics, 2018) although the need for a skilled workforce gradually increases (UND, 2018) in Turkey. Although there have been such an information and many changes in job requirements and the number of criteria needed for employment – due to recent developments in terms of globalisation, information and communication technologies – have made traditional personnel selection processes more obsolete [Korkmaz, 2019; Mutlu and Sari, (2017), p.24], HR managers are proved to be inadequate to choose the right personnel (Korkmaz, 2019) and HR infrastructure in logistics is insufficient in Turkey (Caylan and Yildiz, 2016), they are still heavily used in logistics industry by such managers. However, modern methods of multi-criteria decision-making (MCDM) models emerged due to the failure of available methods in satisfying the needs [Senel et al., (2017), p.24] offer a less costly, less time-consuming/more speedy/more efficient (Senel et al., 2017), more reliable/correct (Korkmaz, 2019; Ployhart et al., (2017), p.295], easier to apply, and compatible with all selection conditions [Khandekar and Chakraborty, (2016), p.251], approach to any kind of PS problem to find a best-match candidate [Karabasevic et al., (2015), p.43].

With such a perspective, it is aimed in this study to evaluate the criteria used in logistics industry in Turkey, to present a reliable MCDM model to select and recruit of a ‘logistics specialist’ in a logistics business through a real case and establish a base for end-users to compare the level of importance of criteria between countries. To reach study objectives, first, PS problems with various methods in literature have been deeply reviewed in different contexts. In addition to literature review, a detailed analysis of job descriptions and online job advertisements and interviews with a group of HR Manager, logistics manager, senior vice president, scholars/consultants and professionals of logistics have been done to define the criteria to employ a ‘logistics specialist’ while overcoming personal biases inherit in PS problems in a major 3PL (assumed to be XYZ Logistics from now on) in Istanbul, Turkey with operations in more than 15 countries in Europe. Having discussed PS, intuitionistic fuzzy sets (IFSs), related definitions, intuitionistic fuzzy (IF)-technique for order preference by similarity to ideal solution (TOPSIS) in literature, the real case represents the applicability of IF-TOPSIS method in logistics. The results are expected to provide fresh insights and valuable information to

students, curricula developers of education and training institutes of logistics, logistics/MCDM model scholars, selection and recruitment agencies, candidates of logistics profession, and owners/shareholders/managers of logistics businesses.

2 Literature review

PS, the starting point of HRM (Risavy and Hausdorf, 2011; Thakre et al., 2017), is defined as the process of identifying, weighting, evaluating (Afshari et al., 2014) and choosing the most appropriate individual (Kundakci, 2016) in a large number – or previously created pool (Karabasevic et al., 2018) – of applicants (Celikbilek, 2018), who meets the predefined criteria and is expected to perform well for a certain job to the most possible extent (Kabak et al., 2012; Kaynak, 2002) based on traditional (i.e., resumes, personality/work sample/job knowledge tests, assessment centres, interviews, background check, etc.) (Chien and Chen, 2008; Alguliyev et al., Mahmudova, 2015) and modern (i.e., computer/internet/multimedia simulation-based tests, phone/video-conference based interviews, etc.) (Alguliyev et al., 2015) experimental and statistical techniques generally used by a group of decision-makers (Bali et al., 2013) whose subjectivity in terms of fairness and adverse effect is a major or minor concern (Celikbilek, 2018). Being different for each and every organisation (Cetin and Icigen, 2017) with aforementioned techniques, a typical PS process involves a detailed job analysis to determine what to expect from an individual if employed, what criteria to be met with their weights (relative importance level in other words), which method to be used to evaluate applicants, and how to validate the final decision (Kabak et al., 2012; Robertson and Smith, 2001; Afshari et al., 2014; Stanujkic et al., 2015). Thus, PS is a complex (Afshari et al., 2016) multidimensional (Aggarwal, 2013) dynamic real life problem with multiple criteria in which any change in businesses, work, personnel, society, rules, regulations, and laws, and marketing needs to be taken into consideration (Borman et al., 1997; Dursun and Karsak, 2010; Dahooie et al., 2018; Robertson and Smith, 2001). It should be noted as well that conventional techniques are not sufficient anymore to distinguish a qualified person from one another (Erdem, 2016) due to higher level of subjectivity (Dagdeviren, 2010; Widiarta et al., 2017) like halo effect (Dahooie et al., 2018), decision-makers' own experience, intuition (Karabasevic et al., 2018) and overconfidence (Kausel et al., 2016) and vagueness of applicants' attributes such as creativity, personality, etc. (Dursun and Karsak, 2010) without biases (Kusumawardani and Agintiara, 2015). Such a case requires a formal, systematic, rational and effective model (Afshari et al., 2014; Turskis et al., 2017) integrating explicit criteria with analytical more precise techniques (Dursun and Karsak, 2010) to overcome fuzzy, uncertain and incomplete information problem existed in PS (Ji et al., 2018). Thus, it leads us to regard PS as a MCDM problem to decrease human errors and personal biases (Kulik et al., 2007) and to compare and rank objects with respect to multiple – usually conflicting – subjective and objective criteria with a finite set of alternatives (Alguliyev et al., 2015; Jasemi and Ahmadi, 2018) to find the best applicant as seen in the extant research on different PS problems with different MCDM models (Dahooie et al., 2018), some of which are summarised in Table 1.

As seen in Table 1, there are various MCDM models in the literature for different PS problems. However, PS seems to be much of a 'definition of criteria' for a position to employ in different hierarchical levels in logistics rather than a problem, which requires a mathematical model to be solved although it plays a vital role in any countries'

national/international trade, income, employment and competitiveness. As far as literature is reviewed, logisticians are expected to be both generalist and specialist with a broad range of in-depth knowledge and expertise in logistics as well as management (Murphy and Poist, 2006) due to globalisation of supply chain, widespread adoption of lean practices (Christopher, 2012). Such a perspective has its reflection in the business – logistics – management (BLM as seen in Table 2) model (Murphy and Poist 1991a, 1991b, 2006, 2007; Stank et al., 1998), which is a repertoire of necessary knowledge and skills for logistics professionals in different levels of hierarchy (Vilela et al., 2018). Although whatever the competencies a logistics professional is expected to have for an employment seems to be similar with regard to developed or developing countries, their importance may vary for different industries or regions [Shou and Wang, (2015), p.12]. In addition to the views of BLM model, the constructs (which might be seen as antecedents of some skills and competencies as well) of education and experience have later been defined as necessary for the logisticians to perform better and create more value in a workplace (Myers et al., 2004) which might contribute to the individual competencies (Derwik et al., 2016). There are some more studies conducted to determine personality traits (Periatt et al., 2007), skills, competencies and knowledge required to be employed or – trained in case if employed to equip with the relevant ones (Silva et al., 2014) – in logistics such as Gammelgaard and Larson (2001), Dotson et al. (2015), Tatham et al. (2017) and Caylan and Yildiz (2016) with respect to hierarchical levels.

In terms of MCDMs applied in PS problems in logistics, there is a little known to us. Having addressed a midlevel manager selection for an international shipping service provider in a hypothetical case, a group of three candidates has been evaluated with three experts through five main criteria of leadership/interpersonal/administrative/professional and conceptual competencies with 20 sub-criteria with a fuzzy approach by Ding et al. (2019). In another study, nine candidates of domestic logistics operation personnel (among 20 applicants) – having met the predefined main criteria of experience, education, flexible work hours, proficiency in MS Office, proficiency in other software used in logistics such as ERP, and references – have been interviewed and rated by seven staff members including a regional director and the employees of HR department in Mersin, Turkey through a TOPSIS method by Korkmaz (2019). Without addressing any specific position or a certain logistics business, vocational (vocational training, use of logistical technologies, experience and reporting skills), technical (computer skills, references and fluency in foreign languages), social (being a team player, effective communication skills and helpfulness) and physical skills (physical endurance, being active and presentable appearance) have been used to evaluate five candidates in accordance with their relative weights through analytic hierarchy process (AHP) as main and sub-criteria in Antalya, Turkey with HR managers of logistics businesses by Ilgaz (2018). In a comparative between fuzzy MULTIMOORA and AHP-TOPSIS methods with similar results to employ a specialist from a group of three candidates for an airline business have been rated by three decision-makers through a three main and eight sub-criteria set of corporate culture, personal (communication skills, being a team member, learning motivation, problem-solving skills) and vocational (planning and organising skills, career development and knowledge and experience) competencies by Kusakci et al. (2019).

Table 1 Literature on PS problems in different contexts with MCDM models

<i>Study</i>	<i>Position</i>	<i>Weighting method</i>	<i>Selection method</i>	<i>Criteria</i>
Alshari and Kowal (2017)	ICT project manager	PROMETHEE	Fuzzy linguistic evaluation procedure	Education, experience, computer knowledge, foreign language, age, gender, labour shift and non-smoker
Alshari and Yusuf (2013)	Project Manager	Fuzzy integral	Fuzzy integral	Basic requirements, project management, management skills and interpersonal skills
Alshari et al. (2010)	Telecommunication staff	AHP	Simple additive weighting (SAW)	Ability to work in different business units, past experience, team player, fluency in a foreign language, strategic thinking, oral communication skills and computer skills
Alshari et al. (2016)	Project manager		PROMETHEE	Foreign language, computer knowledge, experience, age, gender, labour shift, non-smoker and education
Aggarwal (2013)	IT staff	AHP	Fuzzy linear programming	Technical specialties knowledge/skills, technology management knowledge/skills, business functional knowledge/skills, interpersonal and management skills
Akhtaghi (2011)	IT staff	Rough set theory		Technical skills, creativity, self-organisation, reasoning ability, motivation and team working
Alguliyev et al. (2015)	PHD student	Worst-case method	Fuzzy VIKOR	Culture of gathering and perception of information, culture memorisation of information, culture handling of information, culture protection and security of information and culture presentation of information
Ayub et al. (2009)	Personnel	Fuzzy ANP	Fuzzy ANP	Quantitative factors, qualitative factors and zero-one factors
Balezantis and Zeng (2013)	R&D manager	Type 2 fuzzy MULTIMOORA	Type 2 Fuzzy MULTIMOORA	Proficiency in identifying research areas, proficiency in administration, personality, past experience, self-confidence
Balezantis et al. (2012)	Personnel		Fuzzy MULTIMOORA	Creativity, innovation, leadership, strategic planning, communication skills, team management, emotional steadiness, educational background and professional experience
Bali et al. (2013)	System analysis and design director	IF sets	IFS TOPSIS	Leadership, motivation, work experience, proficiency, appearance, creativity, age and communication skills
Baykasoglu et al. (2007)	Project team member		Simulated annealing algorithm	Oral communication, technical expertise, problem solving ability and decision-making
Boran et al. (2011)	Sales manager	IF-TOPSIS	IF-TOPSIS	Oral communication skills, past experience, general aptitude, willingness, self-confidence and first impression
Bukiewicz (2002)	Seller consultant	Fuzzy logic	Fuzzy logic	Cognitive, affective, psychomotor, psychological characteristics
Capaldo and Zollo (2001)	Different positions	Fuzzy logic	Fuzzy logic	Professional skills, managerial skills and personal characteristics
Carlsson et al. (1997)	PHD student	Fuzzy OWA operator	Fuzzy OWA operator	Research interests, academic background, letters of recommendation and knowledge of English
Celik et al. (2009)	Senior Lecturer	Fuzzy AHP	Fuzzy TOPSIS	Personality measures and maritime competency

Table 1 Literature on PS problems in different contexts with MCDM models (continued)

Study	Position	Weighting method	Selection method	Criteria
Celikbilek (2018)	Project manager	Grey AHP	Grey AHP	Basic criteria, character criteria, software criteria, project criteria and energy criteria
Cetin and Içgen (2017)	Front office manager	SWARA	MOORA	Work experience, foreign language knowledge, education, computer skills and personal characteristics
Chen (2000)	System analysis engineer	Fuzzy TOPSIS	Fuzzy TOPSIS	Emotional steadiness, oral communication skills, personality, past experience and self-confidence
Chen (2009)	Mid-level supervisory staff	Fuzzy AHP	Fuzzy AHP	Personal traits and management skills
Chen and Cheng (2005)	IS project manager	Fuzzy multi-criteria group decision support system	Fuzzy multi-criteria group decision support system	Analysis and design skills, programming skills, interpersonal skills, business skills, environment skills and application skills
Chen et al. (2009)	Overseas marketing manager	2-tuple linguistic variable	Fuzzy PROMETHEE	English ability, work experience, market ability and communication ability
Chen et al. (2011)	Engineer	Fuzzy VIKOR	Fuzzy VIKOR	General and professional knowledge criteria
Chaghoooshi et al. (2016)	Project manager	Fuzzy DEMATEL	Fuzzy VIKOR	Site management capacity, technical level, level of leadership, personal qualities and contextual competences
Dagdeviren (2010)	Electronics engineer	ANP	TOPSIS	Ability to work in different business units, past experience, team player, fluency in a foreign language, strategic thinking, oral communication skills and computer skills
Dahooie et al. (2018)	IT professional	SWARA	ARAS-G	Subject competency, social competency, method competency, entrepreneurial competence and personal competence
Dainty et al. (2005)	Construction manager		Generic competency model	Achievement orientation, initiative, information seeking, focus on client's needs, impact and influence, directiveness, teamwork and cooperation, team leadership, analytical thinking, conceptual thinking, self-control and flexibility
Dodangeh et al. (2014)	Project manager	Fuzzy MCDM	Fuzzy MCDM	Basic requirements, project management skills, management skills and interpersonal skills
Drigas et al. (2004)	Persomel	Neuro-fuzzy	Neuro-fuzzy	Age, education, additional education (training), previous experience, foreign language and computer knowledge
Dursun and Karsak (2010)	Industrial Engineer		2-tuple Linguistic TOPSIS	Emotional steadiness, leadership, self-confidence, oral communication skills, personality, past experience, general aptitude and comprehension
Erdem (2016)	Junior software developer	Fuzzy AHP	Fuzzy AHP	Basic technical requirements, individual skills and auxiliary skills
Gargano et al. (1991)	Financial industry staff	Artificial neural networks and genetic algorithms	Artificial neural networks and genetic algorithms	Self-esteem, locus of control, alienation, social responsibility, Machiavellianism, political orientation, education, economic knowledge and experience

Table 1 Literature on PS problems in different contexts with MCDM models (continued)

Study	Position	Weighing method		Selection method		Criteria
		AHP	Fuzzy rule-base	AHP	Fuzzy rule-base	
Gibney and Shang (2007)	Dean	AHP		AHP		Leadership and resources
Golec and Kahya (2007)	Personnel	Fuzzy rule-base		Fuzzy rule-base		Communication skills, personal traits and self-motivation, interpersonal skills and ability to self and ideas, decision-making ability, technical knowledge base skills, career development aspiration and management skills
Gungor et al. (2009)	Personnel	Fuzzy AHP		Fuzzy AHP, Yager's weighted goal method		General work factors, complimentary work factors and individual factors
Huang et al. (2004)	Different positions			Fuzzy neural network		Problem-solving skills, technical skills, human relationship skills, previous work achievement and personality characteristics
Jasemi and Ahmadi (2018)	Industrial engineer	Fuzzy ELECTRE		Fuzzy ELECTRE		Emotional stability, leadership, self-confidence, proficiency in oral communication, personality, previous experiences, competency and general capability, perception and understanding
Javadain et al. (2013)	Human resources manager	Logarithmic fuzzy preference programming (LPPP)		TOPSIS		Analytical thinking, respect to others, willingness, responsibility, appearance, being competitiveness, effective listening, creativity, foreign language, principles of management, organisational behaviour, change management and decision making
Jereb et al. (2005)	Manager	Knowledge base DEXi		Knowledge base DEXi		Work, personnel characteristics and other
Jessop (2004)	Postgraduate admissions officer	Entropy method		Entropy method		Written communication, oral communication, planning, organising ability, team player, works independently and decisiveness
Ji et al. (2018)	Sales supervisor	Neutrosophic fuzzy TODIM		Neutrosophic fuzzy TODIM		Oral communication skills, working experience and general aptitude
Kabak et al. (2012), Kose et al. (2013)	Sniper	Fuzzy ANP		Fuzzy TOPSIS, fuzzy ELECTRE		Physical factors, functional factors and personality factors
Karabasevic et al. (2018)	IT business system support expert	SWARA		EDAS		Education in IT/technical area, relevant work experience, special skills and knowledge of relational database management systems, foreign languages, interpersonal skills, communication and presentation skills
Karsak (2000)	Expatriate	Fuzzy multiple objective programming		Fuzzy multiple objective programming		Personality assessment, leadership excellence, excellence in oral communication skills, past experience, computer skills, fluency in foreign language, aptitude test score and annual salary request
Kasraee and Etemadi (2018)	Personnel	Fuzzy AHP		Fuzzy AHP		Personal characteristics, personality traits, communication skills, decision making skills, management skills, capacities and capabilities and professional and personal skills
Kelemenis and Askounis (2010)	CIO	Fuzzy TOPSIS		Fuzzy TOPSIS		Soft and technical skills
Kelemenis et al. (2011)	Support Manager	Fuzzy TOPSIS		Fuzzy TOPSIS		Creativity/innovation, problem solving/decision making, conflict management/negotiation, empowerment/delegation, strategic planning, specific presentation skills, communication skills, team management, diversity management, self-management, professional experience and educational background

Table 1 Literature on PS problems in different contexts with MCDM models (continued)

Study	Position	Weighting method	Selection method	Criteria
Kersulene and Turskis (2014)	Chief accountant	AHP	Fuzzy ARAS	Education, academic level, long life learning; working knowledge, working skills, work experience, knowledge of legislation systems; responsibility; strategic thinking; leadership; ability to work in team; motivation to work in particular position; computer skills; ability to work with clients, consultants and community
Kusumawardani and Agintiana (2015)	Human resources manager	Fuzzy AHP	Fuzzy TOPSIS	Assessment centre score, level of education, major at school/university, stream march, length of time on stream, talent cluster index, performance index, competence index, length of time on position band and disciplinary sanction
Lin (2010)	Electrical engineer	ANP	DEA	Professional knowledge and expertise; previous professional career and educational background and achievements; and personality and potential
Li Qin et al. (2009)	Project manager		Fuzzy comprehensive evaluation	Site management capacity, technical level, level of leadership and personal qualities
Mahdavi et al. (2008)	System analyst	Fuzzy TOPSIS	Fuzzy TOPSIS	Emotional steadiness, oral communication skills, personality, past experience and self-confidence
Mammadova and Jabrayilova (2014)	Personnel	Fuzzy TOPSIS	Fuzzy TOPSIS	Science and education, behaviour and appearance, personal psychological, functional activity and medical criteria
Mamaan et al. (2014)	Project manager		Fuzzy competency rating	Knowledge of appropriate site layout techniques for repetitive construction works, dedication in helping works contractors achieve works schedule, knowledge of appropriate technology transfers for repetitive construction works, effective time management practices on all project sites, ability to provide effective solutions to conflicts while maintaining good relationships, ease with which works contractors are able to approach the PM with their problem and volunteering to help works contractors to solve personal problems
McIntyre et al. (2010)	Construction management and engineering division director	AHP	AHP	Administration, teaching, research, service and industry
Saad et al. (2014)	Lecturer		Hamming distance method	Experienced in teaching areas, proficiency in performing research, personality assessment and past contribution
Nobari and Zadeh (2013)	Human resources manager	Fuzzy TOPSIS	Fuzzy TOPSIS	Scientific, psychological, behavioural and apparent characteristics, functional characteristics and medical
Pérez et al. (2012)	Web developer	Fuzzy TOPSIS	Fuzzy TOPSIS	Develop applications in PHP, design queries in relational databases, reuse existing classes and develop new classes, use tools for version control, write technical documentation properly and manage their work with tools for project control

Table 1 Literature on PS problems in different contexts with MCDM models (continued)

<i>Study</i>	<i>Position</i>	<i>Weighting method</i>	<i>Selection method</i>	<i>Criteria</i>
Polychronou and Giannikos (2009)	Credit officer	Fuzzy TOPSIS	Fuzzy TOPSIS	Experience in credit analysis, annual salary request, personality profile, leadership ability, communication skills, educational background, age and knowledge of foreign languages
Rahim et al. (2018)	Best employee	TOPSIS	TOPSIS	Job responsibilities, work discipline, work quality and behaviour
Rashidi et al. (2011)	Construction project manager	Fuzzy logic model	Fuzzy logic model	Technical and professional background, educational background, demographic features and general management abilities
Rouyendegh and Erkan (2013)	Academic staff			Work factors, academic factors, and individual factors
Roy et al. (2012)	Personnel			Contacts, communication skills, technical skills, technical skills, creativity, experience, dependability, efficiency
Sadatrassoul et al. (2016)	Project manager	AHP	PCA-TOPSIS	General management, project management and petroleum project management
Sadeghi et al. (2014)	Project manager	Interval Goal Programming	Interval TOPSIS	Knowledge competencies, performance competencies and behavioural competencies
Safarzadegan Gilan et al. (2012)	Project manager and engineer			Technical competencies, behavioural competencies and contextual competencies
Saghafian and Hejazi (2005)	University professor			Publications and researches, teaching skills, practical experiences in industries and corporations, past experiences in teaching, teaching discipline
Saremi et al. (2009)	TQM consultant	Fuzzy TOPSIS	Fuzzy TOPSIS	Knowledge of business, relevant experience, technical skills, management skills, and implementation cost.
Samanloğlu et al. (2018)	IT professional	Fuzzy AHP	Fuzzy TOPSIS	Individual qualifications, technical specifications and general features
Sing et al. (2015)	System analyst engineer		Fuzzy TOPSIS-Karnik-Mendel (KM) algorithm	Emotional steadiness, oral communication skills, personality, past experience and self-confidence
Seol and Sarkis (2005)	Internal auditor	AHP	AHP	Cognitive skills, technical skills, analytic/design skills, appreciative skills, behavioural skills, personal skills, interpersonal skills and organisational skills
Shahhosseini and Sebt (2010)	Project staff	Fuzzy AHP	ANFIS	Technical, behavioural and contextual competencies
Shih et al. (2005, 2007)	Personnel	AHP	TOPSIS	Knowledge tests, skill tests and interviews
Staujkić et al. (2015)	Personnel	—	ARAS	Work experience, education, organisational skills, communication and problem solving skills, computer skills and foreign languages
Hooper et al. (1998)	Officer	BOARDX	BOARDX	Grade, military education level, civilian education level, official photograph, height and weight, assignment history and officer efficiency report evaluations

Table 1 Literature on PS problems in different contexts with MCDM models (continued)

Study	Position	Weighting method	Selection method	Criteria
Thakre et al. (2018)	Branch manager and cashier	AHP	AHP-fuzzy linear programming	Management knowledge/skills, technical knowledge/skills, banking knowledge/skills and marketing knowledge/skills
Jazebi and Rashidi (2013)	Project manager		Fuzzy rule system	Technical and professional records, educational background, demographic features and general management abilities
Turskis et al. (2017)	Estates and economy office director	AHP	ARAS-F EDAS-F	Work experience in similar position, qualifications, leadership skills, motivation, certificates, sociability and ability to work in teams
Urosevic et al. (2017)	Sales manager	SWARA	WASPAS	Communication skills, leadership skills, flexibility, decision making, negotiating skills, analytical skills and consistency
Varajao and Cruz-Cunha (2013)	Project manager	AHP	AHP-IPMA competence baseline (ICB)	Technical competence, behavioural competence and contextual competence
Varmazyar and Nouri, (2014)	Persomel Manager	Fuzzy AHP	Fuzzy AHP	Individual factors, academic factors and work factors
Wan et al. (2013)	Manager	Shannon entropy to	Fuzzy VIKOR	Moral character, work attitude, leadership, cultural level, oral communication and past experience
Wang (2009)	R&D persomel		Grey TOPSIS	Education, work experience, job training, title level, job performance, age, innovation capability and loyalty
Widianta et al. (2017)	Persomel	AHP SAW	TOPSIS PROMETHEE	Knowledge, skill, ability, physical condition, attitude
Wu and Lee (2007)	Global manager	Fuzzy DEMATEL	Fuzzy DEMATEL	Cognitive IQ, emotional IQ, political IQ, cultural/social IQ, organisational IQ, network IQ, innovative IQ and intuitive IQ
Xing and Zhang (2006)	Project manager	Fuzzy AHP	Fuzzy AHP	Knowledge, capability, character and body
Yaakob and Kawata (1999)	Production staff	Fuzzy sets	Fuzzy sets	Speed, quality, leadership, professional knowledge and self-confidence
Yu et al. (2013)	Sales engineer	Generalised hesitant fuzzy prioritised weighted average (GHFPWA) and GHFPWG	Hesitant fuzzy sets	Work attitude, communication skills, problem solving skills and learning skills
Zavadskas et al. (2008)	Project manager	COPRAS-G	COPRAS-G	Personal skills, project management skills, business skills, technical skills, quality skills and time of decision making
Zavadskas et al. (2012)	Project manager	AHP	ARAS	Education, experience and personal skills
Zhang and Liu (2011)	System analysis engineering	IF-GRA	IF-GRA	Emotional steadiness, oral communication skills, personality, past experience, self-confidence
Zolfani et al. (2012)	Quality control manager	AHP	COPRAS-G	Knowledge of product and raw material, experience and educational background, administrative orientation, behavioural flexibility, risk evaluation ability, payment, teamwork

Table 2 Necessary knowledge and skills addressed in business-logistics-management (BLM) model

<i>Business</i>	<i>Logistics</i>	<i>Management</i>
Transportation	Transport and traffic management	Personal integrity
General business administration	Customer service	Motivate others
Business ethics	Warehousing management	Plan
Information systems management	Inventory management	Organise
Business strategy	Materials handling	Self-motivation
Accounting	Log-related regulations	Managerial control
Business writing	Production scheduling	Oral communication
Financial management	Log info management	Supervise others
Human resource management	Order management	Decision making ability
Labour relations	Facilities location	Self-confidence
Microeconomics	Forecasting	Delegate
Quantitative methods	Purchasing	Time management
Procurement	Parts and service support	Negotiate
Organisational psychology	Personnel movement	Adapt to change
Production management	Packaging	Interpersonal relations
Computer science	International logistics	Written communication
Statistics	Return goods handling	Persuasion
Marketing management	Salvage and scrap disposal	Systems concept
Industrial engineer		Listen and empathise
Macroeconomics		Train/mentor
Business and government		Enthusiasm
Business law		Analytic reasoning
Public relations		Operational log tasks
Business and society		Assertiveness
Transport engineer		Personal grooming
Industrial sociology		Personal dress
International business		Statesmanship
Business history		Future threats/opportunities
Economic geography		Quant jock
Insurance and real estate		Outgoing personality
Speech communications		Computer jock
Regional planning		Foreign languages
Foreign languages		Recruit/hire
Electronic commerce		Personal creativity
Supply chain management		Manage supplier relations
Entrepreneurship		Manage customer relations

In lights of previous literature aforementioned in terms of PS problems particularly in logistics, a deep analysis of job description and online advertisements for similar jobs and a group thinking process with HR manager, logistics manager and senior vice president, scholars, consultants and professionals of logistics, graduation, professional experience, computer literacy, fluency in foreign language(s), communication/negotiation skills, analytical thinking and teamwork have been identified since used in job description, referred more than others in literature and online employment advertisements, current problematic qualifications addressed in Industrial Report of Transportation and Logistics (2018) as well as reached on a consensus by group thinking process) as criteria to use for the ‘logistics specialist’ to be employed in XYZ Logistics.

Having purified the criteria with various decision-makers inside and outside XYZ Logistics in different hierarchical levels to overcome the personal biases of each, it is decided in this study to employ an IF-TOPSIS method. As well-known, fuzzy set (FS) Theory proposed by Zadeh (1965) have been identified as a major and widely used technique for a PS problem with a combination of both objective and subjective judgement on criteria required for a job to distinguish between appropriate and inappropriate candidates regardless of the position to be employed due to difficulties in expressing crisp data precisely in decision-making problems. Most of those studies are primarily based on inside/outside experts’ evaluations with different hierarchical levels using ordered and/or weighted average aggregation operators, which assign different selection criteria to guide managers to make a better decision in PS. Based on FS with only a membership function, IFSs have been introduced by Atanassov (1986), which is characterised by a three-parameter membership function, a non-membership function and a hesitation margin to reach a better solution (Xu, 2007a). In such studies, the technique for order preference by similarity to ideal solution (TOPSIS) method has been extensively preferred in the decision-making literature to find a solution for multi-attribute problems to show positive and negative ideal solutions. In this study, TOPSIS method is extended to the IF environment with an intuitionistic fuzzy weighted averaging (IFWA) operator for all involved in a real case of PS to rate the criteria and candidates so that the proposed method represents a comprehensive solution for PS problems faced in the real world.

3 Preliminaries

3.1 Intuitionistic fuzzy sets

As stated before, IFSs of Atanassov (1986) – an extension of classical fuzzy sets developed by Zadeh (1965) – have been used for PS problems since it provides a relatively better solutions to deal with both qualitative and quantitative criteria set defined by the experts. Before a case study, it would be fruitful to describe the basic concepts about IFSs and methodology to use in details about how to calculate logistics specialist applicants’ scores for each criteria and to rank in accordance.

A, being an IFS in a finite set of X , can be stated as in equation (1):

$$A = \{ \langle x, \mu_A(x), \nu_A(x) \rangle \mid x \in X \} \quad (1)$$

where $\mu_A: X \rightarrow [0, 1]$ and $\nu_A(x): X \rightarrow [0, 1]$ are membership and non-membership functions respectively, such that in equation (2):

$$0 \leq \mu_A(x) + \nu_A(x) \leq 1 \quad (2)$$

The hesitancy degree of π_A , – aka the IF index as well – the third parameter of IFS A , is calculated as the difference between 1 and the sum of $\mu_A(x) + \nu_A(x)$ as in equation (3) with $\pi_A(x)$ being $[0, 1]$ as in equation (4) referring the little the $\pi_A(x)$ the more certain the knowledge about x is

$$\pi_A = 1 - \mu_A(x) - \nu_A(x) \quad (3)$$

$$0 \leq \pi_A(x) \leq 1 \quad (4)$$

If A and B are IFSs of the set X , then the multiplication operator (Atanassov, 1986; Despi et al., 2013) can be stated as in equation (5):

$$A \otimes B = \{ \mu_A(x) \cdot \mu_B(x), \nu_A(x) + \nu_B(x) - \nu_A(x) \cdot \nu_B(x) \mid x \in X \} \quad (5)$$

3.2 Intuitionistic fuzzy TOPSIS

TOPSIS is a well-known, widely used and successful method developed by Hwang and Yoon (1981) with a base on ranks of alternatives by calculating the Euclidian distances to the ideal positive and negative solutions. The IF-TOPSIS method, proposed by Boran et al. (2009) is an effective tool to deal with multi-criteria group decision-making problems in an IF environments due to the use of intuitionistic fuzzy numbers (IFNs) instead of crisp numbers to evaluate the criteria and alternatives.

IF-TOPSIS involves eight different steps:

Step 1 Determine the weight of decision-makers:

Let us assume that a group of experts consists of l decision-makers. However, the importance of each decision-maker does not require being equal to each other and should be considered in linguistic terms expressed in IFNs. Thus, the relative weight of each decision-maker in such a group is obtained as in equation (6):

$$\lambda_k = \frac{\left(\mu_k + \pi_k \left(\frac{\mu_k}{\mu_k + \nu_k} \right) \right)}{\sum_{k=1}^l \left(\mu_k + \pi_k \left(\frac{\mu_k}{\mu_k + \nu_k} \right) \right)}, \sum_{k=1}^l \lambda_k = 1 \quad (6)$$

Step 2 Determine the weight of criteria (Xu, 2007b; Boran et al., 2009):

Each decision needs to be fused into a group one to construct an aggregated IF decision matrix with a common use of IFWA operator, proposed by Xu (2007b) in a group decision-making process.

Just like decision-makers, all criteria may not be treated to be of equal importance. The weights of each criteria are to be obtained as in equations (7) and

(8) with the relative importance of decision-makers. The weight vector of criteria is calculated as in equation (9).

$$w_j = IFWA_{\lambda} (w_j^{(1)}, w_j^{(2)}, \dots, w_j^{(l)}) = \lambda_1 w_j^{(1)} \oplus \lambda_2 w_j^{(2)} \oplus \lambda_3 w_j^{(3)} \oplus \dots \oplus \lambda_l w_j^{(l)} \quad (7)$$

$$w_j = \left[1 - \prod_{l=1}^{k=1} (1 - \mu_j^{(k)})^{\lambda_k}, \prod_{l=1}^{k=1} (v_j^{(k)})^{\lambda_k}, \prod_{l=1}^{k=1} (1 - \mu_j^{(k)})^{\lambda_k} - \prod_{l=1}^{k=1} (v_j^{(k)})^{\lambda_k} \right] \quad (8)$$

$$W = [w_1, w_2, w_3, \dots, w_j] \quad (9)$$

Step 3 Construct an aggregated IF decision matrix based on the decision-makers' opinions to turn them into a group decision.

Having determined the weights of criteria and the ratings of alternatives, the IFWA operator has been used once more to aggregate the evaluation of alternatives by each decision-maker. Therefore, r_{ij} , being performance score of each decision-maker to construct aggregated decision matrix with their relative weights obtained in step 1, has been calculated as in equations (10) and (11).

$$r_{ij} = IFWA_{\lambda} (r_{ij}^{(1)}, r_{ij}^{(2)}, \dots, r_{ij}^{(l)}) = \lambda_1 r_{ij}^{(1)} \oplus \lambda_2 r_{ij}^{(2)} \oplus \lambda_3 r_{ij}^{(3)} \oplus \dots \oplus \lambda_l r_{ij}^{(l)} \quad (10)$$

$$r_{ij} = \left[1 - \prod_{l=1}^{k=1} (1 - \mu_{ij}^{(k)})^{\lambda_k}, \prod_{l=1}^{k=1} (v_{ij}^{(k)})^{\lambda_k}, \prod_{l=1}^{k=1} (1 - \mu_{ij}^{(k)})^{\lambda_k} - \prod_{l=1}^{k=1} (v_{ij}^{(k)})^{\lambda_k} \right] \quad (11)$$

Step 4 Construct a weighted aggregated IF decision matrix (Atanassov, 1986):

In this step, relative weights of criteria as of IFNs are multiplied with values in the aggregated decision matrix in this step to construct the weighted aggregated decision matrix as in equation (12).

$$R \otimes W = \{ \langle x, \mu_{A_i}(x) \cdot \mu_W(x), v_{A_i}(x) + v_W(x) - v_{A_i}(x) \cdot v_W(x) \rangle \mid x \in X \} \quad (12)$$

$$\pi_{A_i \cdot W}(x) = 1 - v_{A_i}(x) - v_W(x) - \mu_{A_i}(x) \cdot \mu_W(x) + v_{A_i}(x) \cdot v_W(x) \quad (13)$$

Step 5 Calculate the positive and negative IF ideal solutions:

Let J_1 and J_2 be benefit (the higher the better) and cost (the less the better) criteria with regard to their attributes and A^* and A^- be the IF positive and negative ideal solutions respectively. Then A^* and A^- as of IFNs are calculated with equations (14), (15), (16), (17) and (18).

$$A^* = (\mu_{A^*W}(x_j), v_{A^*W}(x_j)) \quad (14)$$

$$A^- = (\mu_{A^-W}(x_j), v_{A^-W}(x_j))$$

$$\mu_{A^*W}(x_j) = \left(\left(\max_i \mu_{A_i \cdot W}(x_j) \mid j \in J_1 \right), \left(\min_i \mu_{A_i \cdot W}(x_j) \mid j \in J_2 \right) \right) \quad (15)$$

$$v_{A^*W}(x_j) = \left(\left(\min_i v_{A_i \cdot W}(x_j) \mid j \in J_1 \right), \left(\max_i v_{A_i \cdot W}(x_j) \mid j \in J_2 \right) \right) \quad (16)$$

$$\mu_{A^-W}(x_j) = \left(\left(\min_i \mu_{A_i,W}(x_j) \mid j \in J_1 \right), \left(\max_i \mu_{A_i,W}(x_j) \mid j \in J_2 \right) \right) \quad (17)$$

$$v_{A^-W}(x_j) = \left(\left(\max_i v_{A_i,W}(x_j) \mid j \in J_1 \right), \left(\min_i v_{A_i,W}(x_j) \mid j \in J_2 \right) \right) \quad (18)$$

Step 6 Calculate the separation measures of positive and negative ideal solutions:

To measure separation between alternatives and their distances to the positive and negative ideal solutions, distance measures proposed by Szmidt and Kacprzyk (2000) with Euclidian distance can be used. With this view, S^* and S^- , being the separation measures of each alternative from the IF positive and negative ideal solutions respectively, are calculated as in equations (19) and (20).

$$S^* = \sqrt{\frac{1}{2n} \sum_n^{j=1} \left[\left(\mu_{A_iW}(x_j) - \mu_{A^*W}(x_j) \right)^2 + \left(v_{A_iW}(x_j) - v_{A^*W}(x_j) \right)^2 + \left(\pi_{A_iW}(x_j) - \pi_{A^*W}(x_j) \right)^2 \right]} \quad (19)$$

$$S^- = \sqrt{\frac{1}{2n} \sum_n^{j=1} \left[\left(\mu_{A_iW}(x_j) - \mu_{A^-W}(x_j) \right)^2 + \left(v_{A_iW}(x_j) - v_{A^-W}(x_j) \right)^2 + \left(\pi_{A_iW}(x_j) - \pi_{A^-W}(x_j) \right)^2 \right]} \quad (20)$$

Step 7 Calculate the relative closeness coefficient for the alternatives:

The relative closeness coefficient of each alternative, represented as A_i , with respect to the IF positive ideal solution of A^* is obtained as in equation (21).

$$C_i^* = \frac{S_i^-}{S_i^* + S_i^-}, \quad 0 \leq C_i^* \leq 1 \quad (21)$$

Step 8 Rank the alternatives:

Having calculated the relative closeness of each, the alternatives are ranked in a descending order of C_i values.

4 The case study

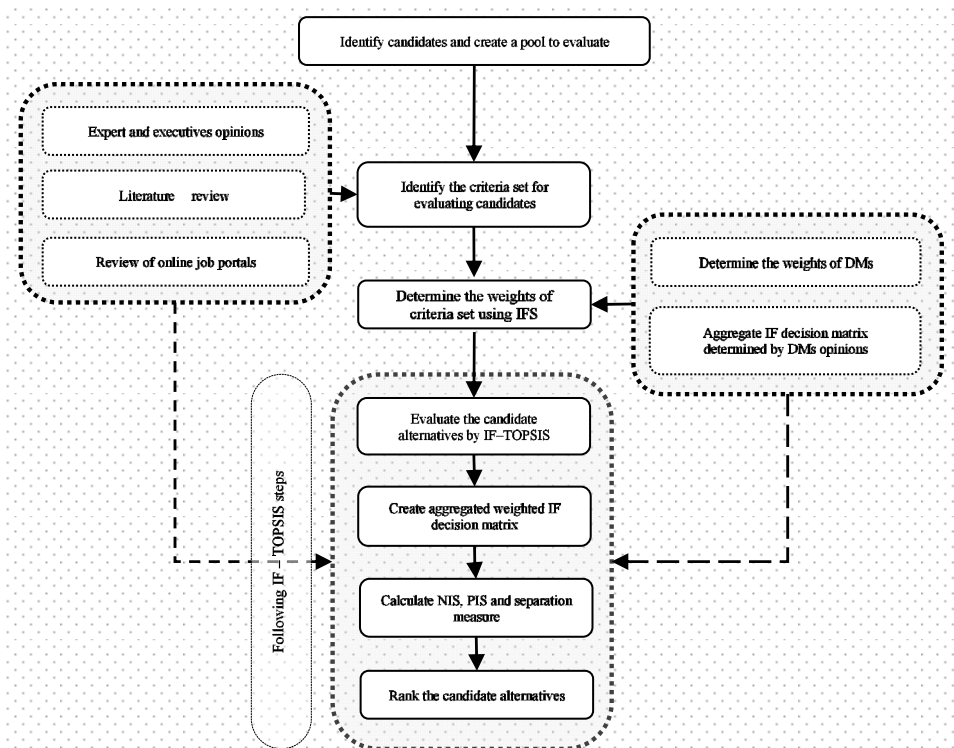
As stated before, XYZ Logistics wants to fulfil a vacant position with a qualified person with a title of ‘logistics specialist’, who will be responsible to manage daily operations of procurement, warehousing, order fulfilment and distribution for a key account in a co-ordination with different business units. Starting from a detailed job description, a set of multiple criteria has been determined in XYZ Logistics by a group of experts such as HR manager, logistics manager and senior vice president with a contribution from scholars, consultants and professionals of logistics. In addition to job analysis, and not to overlook the criteria defined inside XYZ Logistics, 38 different job advertisements with a title of ‘logistics specialist’ (expected to be similar jobs) published on yenibiris.com and kariyer.net (i.e., the largest local online employment platforms of Turkey) have been

analysed to crosscheck and purify the predefined criteria, which are compared with the criteria revealed from an in-depth literature review. Lastly, six different applicants (who have already met the basic criteria) are evaluated to employ a logistics specialist after a pre-elimination in a pool of candidates through a series of face-to-face interviews conducted by that group of experts.

4.1 Methodological framework and research findings

The methodological framework with four main steps is depicted in Figure 1.

Figure 1 The methodology framework



Step 1 Six different candidates have been identified to create a pool of would be employees after a preliminary round to eliminate the applicants who had not met predefined criteria.

Step 2 Criteria set required for candidates to meet have been determined in relation with XYZ Logistics' needs. This set is formed through a detailed job analysis, online job advertisements, literature review and problematic skills addressed in industrial reports by a group of HR manager, logistics manager and senior vice president in collaboration with scholars/consultants and professionals of logistics to evaluate candidates, which consists of the following criteria with the related definitions:

- a *Graduation (C1)*: This assessment criterion includes the highest academic degree or diploma the candidate holds regarding logistics or a related field.
- b *Professional experience (C2)*: This assessment criterion refers the number of years, which the candidate has spent in a similar position to ‘logistics specialist’ in logistics or a related industry so far.
- c *Computer literacy (C3)*: This assessment criterion means the extensive and deep knowledge the candidate has on MS Office as well as ERP software used in logistics.
- d *Fluency in foreign language(s) (C4)*: This assessment criterion evaluates the candidate’s fluency level of English and another language used in countries where XYZ Logistics has operations.
- e *Communication/negotiation skills (C5)*: This assessment criterion defines the effective verbal and written use of languages referred in previous one to persuade others in a discussion aimed at reaching an agreement to create a win-win situation.
- f *Analytical thinking (C6)*: This assessment criterion means the candidate’s ability to relate to or to use analysis or logical reasoning to do something good.
- g *Teamwork (C7)*: This assessment criterion evaluates how much effective and efficient the candidate would be in a cross-functional team.

Step 3 A group of decision-makers has been formed to determine the level of importance with a use of linguistic terms scale expressed in Table 3.

The importance and relative weights of each decision-maker are calculated through equation (6) with a use of IF number equivalents on the linguistic scale and provided in Table 4.

Unique evaluation of each decision-maker for each criterion is shown in Table 5 with a use of IF number equivalents on the linguistic scale expressed in Table 3.

The evaluation of each decision-maker for the criteria as of IFNs, presented in Table 4, have been aggregated with equation (7) to determine the weights of each criterion and shown in Table 6.

Step 4 Following the steps of IF-TOPSIS method, candidates of ‘logistics specialist’ have been evaluated with the use of linguistic terms expressed in Table 7.

Table 3 Linguistic terms scale for ranking the importance levels

<i>Linguistic terms</i>	<i>Intuitionistic fuzzy numbers</i>		
Very unimportant (VU)	0.10	0.90	0.00
Unimportant (U)	0.35	0.60	0.05
Medium (M)	0.50	0.45	0.05
Important (I)	0.75	0.20	0.05
Very important (VI)	0.90	0.10	0.00

Source: Boran et al. (2009)

Table 4 The importance level of DMs and their weights

DM#	Title	Importance	Importance			Weight λ
DM1	Academician	M	0.50	0.45	0.05	0.090
DM2	Professional	VI	0.90	0.10	0.00	0.154
DM3	Academician/consultant	I	0.75	0.20	0.05	0.135
DM4	Academician/consultant	I	0.75	0.20	0.05	0.135
DM5	Professional	VI	0.90	0.10	0.00	0.154
DM6	Academician	M	0.50	0.45	0.05	0.090
DM7	Academician	M	0.50	0.45	0.05	0.090
DM8	Professional	I	0.90	0.10	0.00	0.154

Table 5 The criteria importance weights

Criteria	DM1	DM2	DM3	DM4	DM5	DM6	DM7	DM8
Graduation	C1 VI	I	VI	I	I	I	VI	VI
Professional experience	C2 M	VI	I	VI	I	VI	I	VI
Computer literacy	C3 I	I	VI	M	I	VI	VI	VI
Fluency in foreign language(s)	C4 I	I	I	I	U	VI	VI	I
Communication / negotiation skills	C5 VI	VI	I	VI	VI	VI	VI	VI
Analytical thinking	C6 VI	I	I	VI	VI	VI	VI	VI
Teamwork	C7 VI	VI	I	M	I	VI	VI	VI

Table 6 The aggregated weights of criteria

Criteria		μ	ν	π
Graduation	C1	0.84	0.14	0.02
Professional experience	C2	0.84	0.15	0.01
Computer literacy	C3	0.82	0.16	0.02
Fluency in foreign language(s)	C4	0.75	0.21	0.04
Communication/negotiation skills	C5	0.89	0.11	0.00
Analytical thinking	C6	0.87	0.12	0.01
Teamwork	C7	0.84	0.15	0.01

Table 7 Linguistic terms for ranking the logistics specialist alternatives

Linguistic terms		Intuitionistic fuzzy numbers		
		μ	ν	π
Very weak	VW	0.10	0.75	0.15
Weak	W	0.25	0.60	0.15
Medium	M	0.50	0.50	0.00
Strong	S	0.60	0.25	0.15
Very strong	VS	0.75	0.10	0.15

Source: Boran et al. (2009)

A group of three decision-makers inside XYZ Logistics is formed by HR manager, logistics manager and senior vice president to evaluate the candidates. The relative importance and weight of each of decision-makers are calculated through equation (6) and presented in Table 8.

Table 8 The importance degree of DMs and their weights

DM#	Importance	Importance			Weight λ
		μ	ν	π	
DM1	VI	0.90	0.10	0.00	0.406
DM2	I	0.75	0.20	0.05	0.356
DM3	M	0.50	0.45	0.05	0.238

Unique evaluations of each decision-maker for each candidate are provided in Table 9.

Table 9 The ratings of the logistics specialist alternatives

		<i>C1</i>	<i>C2</i>	<i>C3</i>	<i>C4</i>	<i>C5</i>	<i>C6</i>	<i>C7</i>
A1	DM1	VH	H	H	M	H	M	VH
	DM2	EH	EL	H	M	EH	EH	EH
	DM3	EH	H	H	M	EH	H	EH
A2	DM1	H	L	VH	M	VH	L	H
	DM2	H	EL	H	M	VH	H	H
	DM3	L	EL	H	M	H	M	L
A3	DM1	VH	H	M	M	EH	M	VH
	DM2	EH	EL	M	H	VH	VH	H
	DM3	EH	H	L	L	VH	H	EH
A4	DM1	VH	H	H	VH	VH	H	VH
	DM2	EH	VL	H	H	VH	VH	M
	DM3	H	L	M	M	VH	L	VH
A5	DM1	VH	VH	M	M	M	H	VH
	DM2	EH	EL	M	H	VH	H	M
	DM3	M	VL	L	VL	VH	L	H
A6	DM1	VH	H	VH	VH	H	L	VH
	DM2	EH	EL	H	VH	VH	M	VH
	DM3	H	L	M	H	VH	H	VH

Initial decision matrix has been created with a use of IFN equivalents shown in Table 6 on the linguistic scale presented in Table 8 as follows.

Evaluations of decision-makers presented in Table 9 have been aggregated to form a unique group decision with equation (10) and shown in Table 11.

A performance score of each candidate has been obtained with a use of equation (12) to construct the weighted aggregated decision matrix. Equations (14), (15), (16), (17) and (18) had been used to find the IF positive and negative ideal solutions afterwards. Negative and positive separation measures based on Euclidian distance as well as relative closeness coefficient of each candidate have been calculated as in equations (19), (20) and (21) and presented Table 12.

Table 10 The ratings of logistics specialist alternatives based on IFNs

	weight	C1	C2	C3	C4	C5	C6	C7
A1	DM1	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.8, 0.1, 0.1)
	DM2	(0.9, 0.05, 0.05)	(0.1, 0.85, 0.05)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.9, 0.05, 0.05)	(0.9, 0.05, 0.05)	(0.9, 0.05, 0.05)
	DM3	(0.9, 0.05, 0.05)	(0.7, 0.2, 0.1)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.9, 0.05, 0.05)	(0.7, 0.2, 0.1)	(0.9, 0.05, 0.05)
A2	DM1	(0.7, 0.2, 0.1)	(0.4, 0.5, 0.1)	(0.8, 0.1, 0.1)	(0.5, 0.5, 0)	(0.8, 0.1, 0.1)	(0.4, 0.5, 0.1)	(0.7, 0.2, 0.1)
	DM2	(0.7, 0.2, 0.1)	(0.1, 0.85, 0.05)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.7, 0.2, 0.1)
	DM3	(0.4, 0.5, 0.1)	(0.1, 0.85, 0.05)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.4, 0.5, 0.1)
A3	DM1	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)	(0.5, 0.5, 0)	(0.9, 0.05, 0.05)	(0.5, 0.5, 0)	(0.8, 0.1, 0.1)
	DM2	(0.9, 0.05, 0.05)	(0.1, 0.85, 0.05)	(0.5, 0.5, 0)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)
	DM3	(0.9, 0.05, 0.05)	(0.7, 0.2, 0.1)	(0.4, 0.5, 0.1)	(0.4, 0.5, 0.1)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.9, 0.05, 0.05)
A4	DM1	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)
	DM2	(0.9, 0.05, 0.05)	(0.3, 0.6, 0.1)	(0.7, 0.2, 0.1)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.8, 0.1, 0.1)	(0.5, 0.5, 0)
	DM3	(0.7, 0.2, 0.1)	(0.4, 0.5, 0.1)	(0.5, 0.5, 0)	(0.5, 0.5, 0)	(0.8, 0.1, 0.1)	(0.4, 0.5, 0.1)	(0.8, 0.1, 0.1)
A5	DM1	(0.8, 0.1, 0.1)	(0.8, 0.1, 0.1)	(0.5, 0.5, 0)	(0.5, 0.5, 0)	(0.5, 0.5, 0)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)
	DM2	(0.9, 0.05, 0.05)	(0.1, 0.85, 0.05)	(0.5, 0.5, 0)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.5, 0.5, 0)
	DM3	(0.5, 0.5, 0)	(0.3, 0.6, 0.1)	(0.4, 0.5, 0.1)	(0.3, 0.6, 0.1)	(0.8, 0.1, 0.1)	(0.4, 0.5, 0.1)	(0.7, 0.2, 0.1)
A6	DM1	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.4, 0.5, 0.1)	(0.8, 0.1, 0.1)
	DM2	(0.9, 0.05, 0.05)	(0.1, 0.85, 0.05)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.8, 0.1, 0.1)	(0.5, 0.5, 0)	(0.8, 0.1, 0.1)
	DM3	(0.7, 0.2, 0.1)	(0.4, 0.5, 0.1)	(0.5, 0.5, 0)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)	(0.7, 0.2, 0.1)	(0.8, 0.1, 0.1)

Table 11 The aggregated decision matrix

w	$C1$	$C2$	$C3$	$C4$	$C5$	$C6$	$C7$
	$(0.84, 0.14, 0.02)$	$(0.84, 0.15, 0.01)$	$(0.82, 0.16, 0.02)$	$(0.75, 0.21, 0.04)$	$(0.89, 0.11, 0)$	$(0.87, 0.12, 0.01)$	$(0.84, 0.15, 0.01)$
A1	$(0.87, 0.07, 0.07)$	$(0.56, 0.33, 0.11)$	$(0.7, 0.2, 0.1)$	$(0.5, 0.5, 0)$	$(0.84, 0.09, 0.07)$	$(0.75, 0.18, 0.07)$	$(0.87, 0.07, 0.07)$
A2	$(0.65, 0.25, 0.11)$	$(0.24, 0.69, 0.08)$	$(0.75, 0.15, 0.1)$	$(0.5, 0.5, 0)$	$(0.78, 0.12, 0.1)$	$(0.55, 0.36, 0.09)$	$(0.65, 0.25, 0.11)$
A3	$(0.87, 0.07, 0.07)$	$(0.56, 0.33, 0.11)$	$(0.48, 0.5, 0.02)$	$(0.56, 0.36, 0.07)$	$(0.85, 0.08, 0.08)$	$(0.68, 0.23, 0.09)$	$(0.8, 0.11, 0.09)$
A4	$(0.83, 0.09, 0.08)$	$(0.52, 0.37, 0.11)$	$(0.66, 0.25, 0.09)$	$(0.71, 0.19, 0.1)$	$(0.8, 0.1, 0.1)$	$(0.69, 0.19, 0.11)$	$(0.72, 0.18, 0.1)$
A5	$(0.81, 0.11, 0.08)$	$(0.54, 0.33, 0.13)$	$(0.48, 0.5, 0.02)$	$(0.55, 0.38, 0.07)$	$(0.71, 0.19, 0.1)$	$(0.65, 0.25, 0.11)$	$(0.69, 0.21, 0.1)$
A6	$(0.83, 0.09, 0.08)$	$(0.48, 0.42, 0.11)$	$(0.71, 0.19, 0.1)$	$(0.78, 0.12, 0.1)$	$(0.76, 0.13, 0.1)$	$(0.52, 0.4, 0.07)$	$(0.8, 0.1, 0.1)$

Table 12 The relative closeness coefficient and separation measures of each candidate

	S^+	S^-	C	Rank order
A1	0.360	1.237	0.774	1
A2	1.212	0.395	0.246	6
A3	0.605	1.003	0.624	4
A4	0.418	1.209	0.743	2
A5	0.922	0.710	0.435	5
A6	0.469	1.127	0.706	3

Six candidates of logistics specialist to be employed in XYZ Logistics have been ranked in a descending order of C_i values as $A1 \succ A4 \succ A6 \succ A3 \succ A5 \succ A2$, which implies that A1 is the most appropriate candidate to fulfil the vacant position of ‘logistics specialist’ whereas A2 is the most inappropriate.

5 Conclusions

In a complex, uncertain gradually changing and developing competitive environment, businesses, regardless of size, scale or the industry, need to differentiate themselves in order to survive with a base of human capital, which is very pretty hard to be duplicated by competitors. Therefore, talent seems to be one of the critical elements of a business to achieve superior performance compared to its rivals particularly in an industry with a high level of employee-turnover rate where all is done for people by people. In a sense, selection, recruitment and retention of the right person for the right job provides a business with a better chance in terms of organisational success since people make a difference in terms of positive outcomes such as competitive advantage, innovation, less loss in productivity, precision flexibility, quality of a product, less industrial accidents. Besides, a wrong decision made on such a phenomenon is hard to take back due to direct and indirect costs of firing a bad performer and employing a new one. That’s why PS problem has been taken seriously.

Due to a complex, multidimensional, integrated and coordinated international structure with different decision levels, logistics industry has gradually become one of the fiercest industries with a growing need of professionals with more than hundreds of skills, which makes particular concern of this study. It should be noted that little has been known about PS problems in logistics in international context. In a sense, this study differs the other ones from avoiding a pure perspective of US, Europe or Asia since Turkey is a Eurasian country, a bridge between Europe and Asia and reflects an emerging economy. With this perspective, to overcome the global changes in job descriptions, HR infrastructure and management problems of selection and recruitment process in Turkey and challenges addressed in previous sections related to traditional PS, this study aims to provide a more systematic manner to develop an employment strategy accompanied by a MCDM model for an industry in an emerging country context with her own problems to attract and retain logistics professionals. In addition, this study employs a hybrid technique different from other studies related to the PS problem to develop a set of criteria to use for a selection process of a ‘logistics specialist’ through a job description, a comparison with similar ones published online employment platforms, literature review

and a group-thinking process of scholars and practitioners as well as managers of a logistics business with different hierarchical levels.

Based on BLM Model proposed by Murphy and Poist (1991a, 1991b, 2006, 2007; Stank et al., 1998), the logistics professional seems to be hard-to-find talent (Vilela et al., 2018) with a lot of skills and knowledge addressed in the aforementioned literature. However, decision-makers do not seem to be interested other than graduation, professional experience, computer literacy, fluency in foreign language(s), communication/negotiation skills, analytical thinking and teamwork. With these criteria in hand, a MCDM model of IF-TOPSIS has been applied and results indicate that 'communication / negotiation skills' as the most important criterion with a higher weight given by the experts for a candidate of 'logistics specialist' to be employed, followed by 'analytical thinking', 'graduation', 'professional experience', 'teamwork', 'computer literacy', and 'fluency in foreign language(s)', respectively. Most of other skills and knowledge than the seven criteria addressed in this study are taught to be accumulated through a formal education from institutions of technical education, higher education or graduate school (Vilela et al., 2018) of more than 180 programs as of today in logistics with a curricula basically based on business related courses or a professional experience in logistics or a related field in contrast to Vilela et al. (2018). Nevertheless, this study confirms the importance the multidisciplinary nature of logistics and provides a profile of 'logistics specialist' with a list of skills, which a logistics business or selection and recruitment agency can use when searching and training and developing a logistics workforce. Such a list presents an opportunity to students and candidates of logistics as well to learn what skills they are expected to have to be employed. This study contributes to the educators as well to see what skills are required to be included in curricula of logistics in addition to professional training programs offered in the market or a business' own academy from an emerging economy perspective.

Based on such seven criteria, six different candidates of A1, A2, A3, A4, A5 and A6 have been evaluated by the HR manager, logistics manager and senior vice president with their relative weights in the employment decision for XYZ Logistics. When it comes to the final decision, A1 seems to be the most appropriate candidate to fulfil the vacant position of 'logistics specialist' whereas A4, A6, A3, A5 and A2 are ranked respectively as least appropriate options. However, it should be noted that the employment decision of A1 should be evaluated sometime soon through a performance appraisal system so that how good this decision is for XYZ Logistics. In a broader sense, more performance, satisfaction, loyalty, motivation and less stress, work accidents from employees with a protected physical and mental health due to the alignment between job requirements and required skills/knowledge have been expected in XYZ Logistics in case it keeps up with this systematic manner of less time/effort-consuming and more cost-effective MCDM models.

This study may be repeated with more criteria in different hierarchical levels through various MCDM methods in a (national/international) context of road, sea, air, rail transportation or warehouses or even logistics departments of retail/manufacturing businesses.

In addition to PS problems, it should be noted that this model can be used for different MCDM environment such as location/supplier/project/software/machinery selection decisions.

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