# 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.

**Reference** to this paper should be made as follows: Altuntas, G. and Yildirim, B.F. (2022) 'Logistics specialist selection with intuitionistic fuzzy TOPSIS method', *Int. J. Logistics Systems and Management*, Vol. 42, No. 1, pp.1–34.

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This paper is a revised and expanded version of a paper entitled 'Personnel selection via intuitionistic fuzzy TOPSIS method: a logistics business case' presented at Second National Congress of Transportation and Logistics, Sakarya, Turkey, 22–23 November 2018.

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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; Widianta 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

| *Study* | *Position* | *Weighing method* | *Selection method* | *Criteria* |
|---|---|---|---|---|
| Afshari and Kowal (2017) | ICT project manager | PROMETHEE | Fuzzy linguistic evaluation procedure | Education, experience, computer knowledge, foreign language, age, gender, labour shift and non-smoker |
| Afshari and Yusuff (2013) | Project Manager | Fuzzy integral | Fuzzy integral | Basic requirements, project management, management skills and interpersonal skills |
| Afshari 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 |
| Afshari 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 |
| Akhlaghi (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 |
| Balezentis 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 |
| Balezentis 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 |
| Butkiewicz (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* | *Weighing 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 Icigen (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 |
| Chaghooshi 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) | Personnel | 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* |
|---|---|---|---|---|
| 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 sell 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 |
| Javadein et al. (2013) | Human resources manager | Logarithmic fuzzy preference programming (LFPP) | 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* | *Weighing method* | *Selection method* | *Criteria* |
|---|---|---|---|---|
| Kersuliene and Turskis (2014) | Chief accountant | AHP | Fuzzy ARAS | Education, academic level, long life learning; working knowledge, working skills, work experience, knowledge of legislation system; 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 Agintiara (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 |
| Liqin 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 |
| Manaan 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)

| *Study* | *Position* | *Weighing method* | *Selection method* | *Criteria* |
|---|---|---|---|---|
| Polychroniou 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 |
| Sadatrasool 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. |
| Samanlioglu et al. (2018) | IT professional | Fuzzy AHP | Fuzzy TOPSIS | Individual qualifications, technical specifications and general features |
| Sang 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 |
| | | – | TOPSIS | |
| Stanujkic et al. (2015) | Personnel | SWARA | ARAS | Work experience, education, organisational skills, communication and problem solving skills, computer skills and foreign languages |
| Hooper et al. (1998) | Officer | BOARDEX | BOARDEX | 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* | *Weighing 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) | Personnel | 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 personnel | | Grey TOPSIS | Education, work experience, job training, title level, job performance, age, innovation capability and loyalty |
| Widianta et al. (2017) | Personnel | 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

| *Business* | *Logistics* | *Management* |
|---|---|---|
| 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):

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

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

$$0 \leq \mu_A(x) + v_A(x) \leq 1 \tag{2}$$

The hesitancy degree of $\pi_A$, – aka the IF index as well – the third parameter of IFS $A$, is calculated as the difference between 1 and the sum of $\mu_A(x) + v_A(x)$ 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

$$\pi_A = 1 - \mu_A(x) - v_A(x) \tag{3}$$

$$0 \leq \pi_A(x) \leq 1 \tag{4}$$

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):

$$A \otimes B = \{\mu_A(x) \cdot \mu_B(x), v_A(x) + v_B(x) - v_A(x) \cdot v_B(x) \mid x \in X\} \tag{5}$$

## 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):

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

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).

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

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

$$W = \left[w_1, w_2, w_3, \ldots, w_j\right] \quad (9)$$

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).

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

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

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).

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

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

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).

$$\begin{aligned} A^* &= \left(\mu_{A^*W}(x_j), v_{A^*W}(x_j)\right) \\ A^- &= \left(\mu_{A^-W}(x_j), v_{A^-W}(x_j)\right) \end{aligned} \quad (14)$$

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

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

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

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

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).

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

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

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).

$$C_{i^*} = \frac{S_{i^-}}{S_{i^*}+S_{i^-}}, \quad 0 \le C_{i^*} \le 1 \tag{21}$$

Step 8 Rank the alternatives:

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

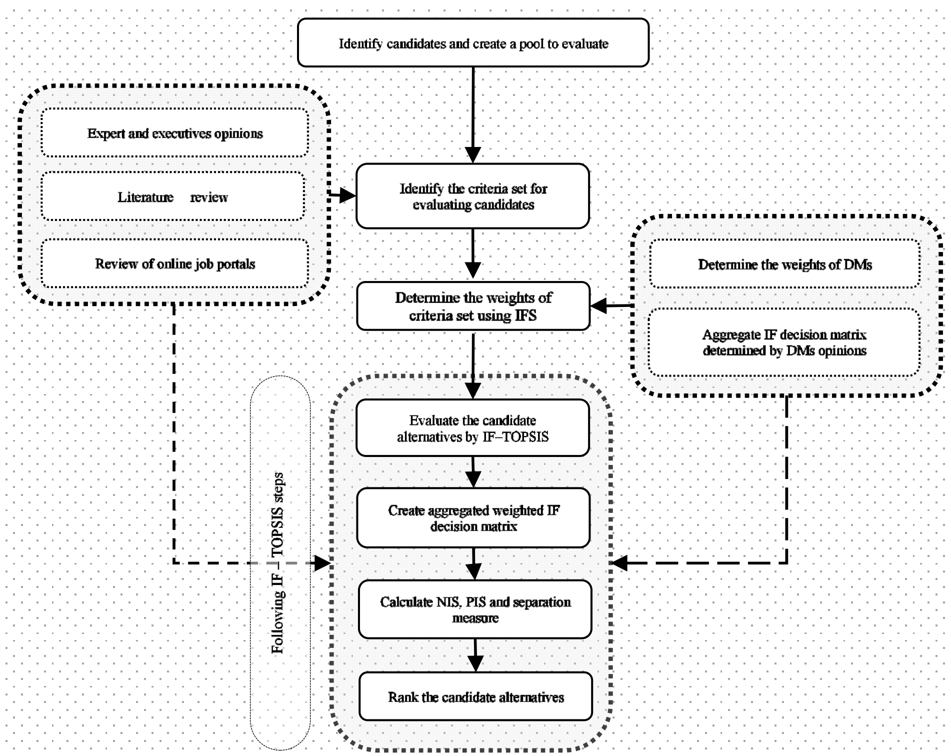
## 4 The case study

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

| *Linguistic terms* | *Intuitionistic fuzzy numbers* | | |
|---|---|---|---|
| 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* | *v* | *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* | *v* | *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* |
|---|---|---|---|---|---|
| | | $\mu$ | $v$ | $\pi$ | $\lambda$ |
| 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

| | | *C1* | *C2* | *C3* | *C4* | *C5* | *C6* | *C7* |
|---|---|---|---|---|---|---|---|---|
| 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 | 0.41 | (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 | 0.36 | (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 | 0.24 | (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 | 0.41 | (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 | 0.36 | (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 | 0.24 | (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 | 0.41 | (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 | 0.36 | (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 | 0.24 | (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 | 0.41 | (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 | 0.36 | (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 | 0.24 | (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 | 0.41 | (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 | 0.36 | (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 | 0.24 | (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 | 0.41 | (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 | 0.36 | (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 | 0.24 | (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* | *(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)* |
|---|---|---|---|---|---|---|---|
| | *C1* | *C2* | *C3* | *C4* | *C5* | *C6* | *C7* |
| 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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