

Research Article

THE LOCATION OF INDUSTRIAL COMPLEX USING COMBINED MODEL OF FUZZY MULTIPLE CRITERIA DECISION MAKING (INCLUDING CASE-STUDY)

¹Zahra Khorasani and ^{2,*} Mohammad Taghipour

¹Industrial Engineering, Ghiaseddin Jamshid Kashani, Non-Profit University, Qazvin, Iran

² Young Researchers and Elites club, Science and Research Branch, Islamic Azad University, Tehran, Iran

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ABSTRACT

One of the important factors in competitiveness of industrial complexes is to determine the best site to establish them and lack of observation of scientific criteria in locating can lead to various problems. This study is a descriptive design. To formulate theoretical framework and review of literature, library method, questionnaire, interview and internet searching are used. To establish this industrial complex, some items of special and free zone are selected. In this study, fuzzy multi-criteria decision making methods are used. To do this, for prioritization of criteria including costs, human, technique, geographical conditions, economic conditions, transportation network, rules, suppliers and consumers, FAHP method and for prioritization of sites, FVIKOR method is used. A questionnaire is designed for classification and reduction of criteria and another questionnaire is designed to prioritize the criteria and sites and they are distributed among 10 special and free zone experts. After data analysis, the rules were the most effective criterion and Shiraz special zone was the best site to establish this industrial complex.

Keywords: Locating, Industrial complex, Fuzzy Multiple Criteria Decision Making, FAHP, FVIKOR

INTRODUCTION

Rapid development of urbanization has encountered most countries including our country with various problems as not only urbanization policies but also socio-economic and environmental issues of most of urban regions are affected by this phenomenon (Hosseinzade *et al.*, 2012). Indeed, the most important factor of this sudden development of cities and these problems is the development of industry. In two recent centuries, the formation of industrial community has created many cities in the world. In 1900, there were only 16 cities with the population of more than 1 million people and in 1997, this reached 320 cities and it is expected that by 2015, these cities are increased to 543 and more than half of them are in developing countries. Thus, finding an optimal limit in which besides employment, production increase, self-sufficiency, increase of gross income and similar items, environment and residents are not damaged or damage is reduced can be of great importance (Davitaya, 1982: 373-382). Industrial Park is a place with definite area as its spatial location is determined in accordance to location regulations of industrial projects and based on development strategy of industrial parks and the infrastructural utilities and technical services regarding industrial activities are established in location of Industrial Park (Kapur & Graedel, 2004: 373-382). As specialized complex is established in one of the existing parks in special zones of Mahshahr, Salafchegan and Fars or free zone of Arvand. Thus, site selection is used in establishment of industries to avoid environmental crisis and sustainable use of facilities of a country is one of the new issues receiving much attention by the government namely management and planning organization and environment protection organization (Jafari & Karimi, 2005).

Location

Selection of a suitable site in a city or extramural is an important decision dating back to 18th century. Von Thunen (1826) by his own

agriculture model presented an economic analysis of the regions in which agriculture is performed. The result of this model is concentric circles determining the position of cultivation of products (Ziari, 2010). The significance of his model is to link economic concepts with the sites (Seifoldini, 1999). Also, Leonhard (1882) developed a location triangle for a given factory in which points represented the sources of the materials it used and the third point was the market where it sold its products. He determined the optimal location as the point within the triangle at which the shortest lines met from the three points (Parhizkar, 1997). The industrial location theory of Weber was published in 1909 and presented an industrial location with the least cost and these locations had the lowest transportation costs. The Walter Christaller central place theory was published in 1933 in Germany and was translated into English in 1966. This book was based on the theories of Von Thunen, Weber and Englander (Shakuyi, 2012). The approaches of Weber had good flexibility in location selection and close distance to location reality as Palander (1935) and Hoover (1937) used isodapanes (isolines) extensively for locating with the cost –distance ratio. Hitchcock (1941) to respond the location with various variables based on supply and demand for different factories and places, presented a math model in which transportation costs were minimized to distribute products from different factories for customers in different areas of the region. Later, Koopmans and Beckman (1957) extended the model for n factories in n places in which net profit was increased (Kuchakzade, 2001). Later, central place theory of August Losch (1954) besides the verification of Christaller model supported a continuous relationship between population size and locational centrality ratio of a region (Misra, 1973). Losch principle of least effort (that people will generally attempt to minimize the effort needed to do business, i.e., all else equal, they will trade at the nearest retail establishment) was presented as the main principle of central place. Also, Lary model proposed an inductive solution for problem solving. This model was presented at first to predict population, employment and dedicate its growth to the special sub-zones and it led into residential location.

*Corresponding Author: Mohammad Taghipour

Young Researchers and Elites club, Science and Research Branch, Islamic Azad University, Tehran, Iran

Generally, regarding location models, after the studies of Von Thunen and Leonhard, three separated classifications are defined as:

- a. Formulation of the problem including the era of Weber to 1940s.
- b. Application of models in industry sector during 1950s, 1960s.
- c. Develop models in public sectors and service providing since 1960s.

Review of literature

• Local studies

The location of industrial centers has received much attention from the researchers and some of them include:

Khalesi (2008) in his MA thesis evaluated the condition of industrial parks of Iran Khodro in Takestan of Ghazvin province. He introduced social, economic, geographical, locational, access infrastructures and organizational institutions criteria as effective factors on location of industrial parks. He also used AHP method and found that in location of industrial parks of Iran Khodro, the following access infrastructural factors had the highest significance. Also, after evaluation of economic, social, industrial and physical capabilities, it was shown that the location of industrial parks of Iran Khordo was optimal.

Zaghian et al., (2008) in his study to select the best site to establish a crude oil refinery among some provinces, applied the combination of MADM, AHP, VIKOR methods. At first, all important criteria are identified and classified. Decision making process includes two phases: in the first phase of decision making, the weights of sub-criteria (via pair-wise comparison) and scores of choices for each set of criterion by AHP method are computed and the main decision matrix is formed by these methods. In the second phase, VIKOR method is used. By the combined methods, Kermanshah and Khorasanrazavi are proposed sites to establish crude oil refinery. Shad et al., (2009) evaluated industrial parks of Azarbayijan Sharghi province and considered natural factors (wind, slope, earthquake, river, etc.), infrastructural facilities (water, electricity, gas, telephone), environment (air pollution, protection of forest, pastures, avoiding the extinction of animals, etc.) access (road, Railway, labor, educational and health facilities, etc.) as effective factors on location of industrial parks and combined models, index overlapping model, fuzzy sum, fuzzy gamma, genetics in location process. The four mentioned factors were compared in the mentioned models. The results of study showed that the best model for location of Industrial Park based on the mentioned factors is index overlapping model. In a study done by Nasrollahi and Salehi (2012), effective criteria on location of industrial parks was determined based on sustainable development indices. The study of existing literature and experts' opinion shows that social, economic, environmental, infrastructural and planning criteria are effective criteria on location of industrial parks based on sustainable development indices. The prioritization of criteria is performed by fuzzy AHP and triangular fuzzy number. Based on the mentioned method, data collection is made by fuzzy Delphi method and experts opinion with location expertise in theory and practice. The results of study show that socio-economic criteria are the most important factors on location of industrial parks. The main emphasis of Kavarian Garmsir (2014) is on principles of spatial planning and land monitoring. For data analysis, Analytical Network Process (ANP), Analytical Hierarchy Process (AHP), GIS Fuzzy, SOAR strategic model are used. The indices are collected from different special levels. After evaluation at national and regional levels, it is shown that Yazd province has good location capability to establish industrial parks. Indeed, some advantages as locating in the main communication lines, suitable access to ports, target markets and its

suitable geographical condition, required man power including expertise and capital, no natural threats as fault and protection against wild life area, etc. are important features. The studies of location of industrial park of Yazd city show that the present location of Industrial Park is not in an optimal place. Indeed, there are other suitable sites in the east and southeast of province. Futurism is a part of spatial planning principles and strategic development plan of industrial park of Yazd is important.

Abdi Hevelayi *et al.*, (2019) studied Predicting Entrepreneurial Marketing through Strategic Planning (Including Case Study). In the relevant study, the relationship between strategic planning and entrepreneurial marketing in Bank Saderat in the northern region of Tehran was examined.

Haj Abukahaki *et al.*, (2019) studied Identificaion and prioritization of effective indicators on optimal implementation of customer relationship management in the insurance industry (including case study). The present Nowadays, importance of customer within organizations has gone beyond such that the trend of organizations has changed from product-orientation to customer-orientation. Therefore, since the last decade, approach to the issues such as customer relationship management has increased within organizations, that the organizations have felt necessity of the issues such as understanding the customer's needs, reducing the costs for acquisition of new customers, and maintain old customers.

Taghipour *et al.* (2015) studied Risk analysis in the management of urban construction projects from the perspective of the employer and the contractor. Imbalance between anticipated and actual progress in the development of urban construction projects suggests that there are many obstacles and risks which not only causes the urban management be unsustainable, but the reconstruction and development of urban space is also seriously threatened. the results indicated that the experts listed the most significant risks as the delays in the payment of contractors' claims and statements due to the lack of handling financial instruments, the governance of relationships rather than rules in the tenders resulting from employer actions, low commitment to the quality of work provided by their subcontractors, failure to complete the detail engineering by foreign contractors on time, weaknesses in contractors' financial resources, and offering lower prices than reasonable by contractors to win the tender. Finally, the solutions for eliminating or reducing risks in high risk areas have been offered to provide tranquility for contractors and employers.

Rezvani Befrouei *et al.*(2015) discussed Identification and Management of Risks in Construction Projects. Today, risk management in construction projects is considered to be a very important managerial process for achievement of project's objectives in terms of time, costs, quality, safety, and environmental sustainability. Instead of employing a systematic approach for identification of risks, their probability and their effects, most of the studies conducted in this area have focused only on a few aspects of risk management in construction project. The present study aims to identify and analyze the risks associated with development of construction in the greater city of Tehran, employing a comprehensive approach that is consisted of five aspects. After the collection and observation of the data, the output was examined by Pearson correlation also, using charts and tables. The results indicated that "tight project schedule" present in all five categories- imposed the maximum risk. Also "design variations", "excessive approval procedures in administrative government departments" and "unsuitable construction program planning" were identified as next high risk factors.

Alamdar khoolaki *et al.* (2019) studied Effect of integrated marketing communication on brand value with the role of agency's reputation. In today's world, the core capital of many organizations is the brand of that organization. In this research, the effect of integrated marketing communications on brand value has been considered with the mediating role of the reputation of the organization in Iranian insurance.

Taghipour *et al.* (2015) studied Analysing the Effects of Physical Conditions of the Workplace on Employees Productivity. One of the issues that today will improve the productivity of any organization is attention to the human factors engineering. The aim of this study was to find the amount of employee's satisfaction from environmental and organizational factors of their jobs, thus providing guidelines for improving the identified problems which eventually will lead to increase the productivity.

Baghipour sarami *et al.* (2016) studied Modeling of Nurses' shift Work schedules According to Ergonomics: A case study in Imam sajjad (As) Hospital of Ramsar. In this study, 35 nurses working in the emergency ward of Imam Sajjad (AS) Hospital of Ramsar city, Iran, were considered. The final model was implemented with GAMS and at the end, shift working with ergonomic criteria were proposed. The results showed that the proposed working program on one hand will improve satisfaction and efficiency of nurses and on the other hand it can decrease the effects of disorders on shift work.

Taghipour *et al.* (2015) studied Supply Chain Performance Evaluation in IN The IT Industry. The appraisal of several performance measure agendas and metrics already accessible proposes that supply chain performance measure can be detected under different categories such as cost and non-cost. In this study, developed supply chain of IT industry based on BSC from existing decision making models. Then, industrial projects performance and performance evaluation measures have been determined using a designed questionnaire.

Taghipour *et al.* (2018) studied the Study of the Application of Risk Management in the operation and Maintenance of Power Plant Projects. one of the methods used in good decision making, pay attention to risk management, which is known as an important part of project management and control. Risk management has evolved over time and its systematic method has provided managers with a definite path so that they reduce potential threats to a minimum and reach project goals by the least possible deviations. In this paper, subsequent to an introduction of fundamental concepts of risk, risk management, an account of risk management, methods and its techniques are presented. In the end, following a discussion on how it is practically used in projects in a real and practical sample, risk management and its application are implemented and essential investigations are undertaken into its effects.

Mahboobi *et al.* (2020) discussed Assessing Ergonomic Risk Factors Using Combined Data Envelopment Analysis and Conventional Methods for an Auto Parts Manufacturer. Occupational injuries are currently a major contributor to job loss around the world. They are also costly for business. The absence of rational analysis is felt in this area, so mathematical analysis is needed to obtain the logical results of these injuries in order to find gaps or loss points of industry. OBJECTIVE: This paper assesses the effect of five demographic factors on ergonomic risk and occupational injuries using an integrated mathematical programming approach. The obtained results will help managers to carry out any required corrective actions or establish benchmarks.

Taghipour *et al.* (2020) studied Assessment and Analysis of Risk Associated with the Implementation of Enterprise Resource Planning

(ERP) Project Using FMEA Technique. Enterprise resource planning (ERP) is one of the latest management tools that can take advantage of information technology to comprehensively gather resources and information in all parts of the organization by an interlocking, system with fast speed and high quality and help users in all organizations and sectors by giving certain modules for managing different sectors such as projects, human resources, and services. Despite the many benefits this system can have for the organization, its implementation and deployment is very risky and costly.

Azarian *et al.* (2020) studied The effect of implementation total quality management on job satisfaction(A case study). The results showed a significant difference between the implementation of TQM and increasing job satisfaction in the education organization.

Taghipour *et al.* (2015) studied Construction projects risk management by risk allocation approach using PMBOK standard. Projects' managers in plenty of construction projects which are assumed that are under control, are facing risk as an unknown occurrences and they are attempting to control it and are suffering more costs. Though, by a comprehensible effort and applying risk management, risks are identified and controlled before happening or a plan is provided in order to deal with these occurrences and time and cost are saved. Thus, they have to be controlled and appropriately responded by risk management methods. In this regard, risk management process in PMBOK standard can be a suitable approach to solve this problem.

Taghipour *et al.* (2015) studied The Evaluation of the Relationship between Occupational Accidents and Usage of Personal Protective Equipment in an Auto Making Unit. One of the problems that encounter each work society is occupational accidents. Today, despite the improvements of facilities and working conditions, the possibility of accident occurrence in workplaces and especially in industrial places is inevitable. Since the non-use or misuse of PPE is one of the main causes of accidents in industrial units, the aim of this study is to evaluate the association between occupational accidents and the use of PPE in the body section of a vehicle manufacturing unit. The results showed that there is a meaningful positive relationship between the factor of inadequate PPE and probable hazards of the industrial workplace.

Taghipour *et al.* (2015) studied Necessity Analysis and Optimization of Implementing Projects with The Integration Approach of Risk Management and Value Engineering. Risk management and value engineering have appeared as modern management tools since the mid-19th century and have been used separately in different projects. Due to the ineffectiveness resulting from separate implementation of the two approaches in major projects as well as the similarity between them in terms of their goals and executive structures, this research tries to analyze the separate role of each approach in the project process and examine the possibility of integration and correlation between their different phases. This article aims at introducing and examining a tool that simultaneously has the capability of the two categories.

Taghipour *et al.* (2020) studied Evaluating Project Planning and Control System in Multi-project Organizations under Fuzzy Data Approach Considering Resource Constraints. Projects can be repetitive tasks in specified periods of time and also it may involve some functions which are performed just once. However, in any project, managers and experts consider three basic and important goals: least time, lowest cost and best quality, so all efforts are directed toward achieving these basic goals. Statistics indicate that

projects are either conducted on estimated time or delayed and rarely are delivered before due date.

Taghipour *et al.* (2015) studied Implementation of Software-Efficient DES Algorithm. By increasing development of digital telecommunication and the increase of sending and receiving data of various network of data transfer, protection of the safety of data are the most important necessities of the current world. The increase of different bank trading, increasing use of smart cards, moving to electronic government, are the examples of significance of this issue. In this study, an efficient algorithm implementation by MATLAB and C language is presented and is compared with the latest works in this field.

Taghipour *et al.* (2015) studied Risk assessment and analysis of the state DAM construction projects using FMEA technique. Dam construction projects are the most important projects of the country and absorb a considerable amount of the state budget on annual basis. As they take a long time to be completed, they always face risks and many uncertainties. In this study, the researcher intends to use a highly applied qualitative-quantitative methodology (FMEA) to analyze the risks of state dam.

Taghipour *et al.* (2016) studied the impact of ICT on knowledge sharing obstacles in knowledge management process. Today, knowledge is known as a valuable asset in any organization so management of such insensible asset is one of the factors cause success in organizations. But knowledge can be effective when it is shared across the organization. Therefore, knowledge sharing is a key element in the process of knowledge management. This study aimed to check the impact of ICT on knowledge sharing barriers in one of the mobile operator, in Tehran.

Taghipour *et al.* (2016) studied Assessment of the Relationship Between Knowledge Management Implementation and Managers Skills. The Purpose of this study is to consider the effects of knowledge management implementation on manager's skills of Reezmouj System Company. Results showed that there is a relation between knowledge management.

Taghipour *et al.* (2015) studied Evaluation of the effective variables of the value engineering in services. The value engineering is a systematic method for resolving the problems, reducing the cost and improving the function and quality simultaneously and this leads to the increase of customer satisfaction by investigating and improving the value index. The results of this research which are based on the post managers and specialists responses show that applying value engineering by the post managers has significant effects on reducing the cost, saving time and customer satisfaction.

Khalilpour *et al.* (2018) studied The Impact of Accountants Ethical Approaches on the Disclosure Quality of Corporate Social Responsibility Information an Islamic in Iran. The focus of business units on maximizing profits, tackling competitive challenges, emphasizing short-term outcomes, and delivering diverse accounting services has put accountants in a climate of conflict and pressure that has led to unethical outcomes for them. The main purpose of this study is to test a modified Multidimensional Ethics Scale (MES) to measure the ethical evaluations of accountants and financial managers.

Taghipour *et al.* (2015) studied Identification and Modeling of Radio Wave Propagation Channel in Industrial Environments. Wireless technology in industrial environments is considered due to potential

for saving in cable cost, high flexibility in factories, tracing the products and increasing optimization of process.

Taghipour *et al.* (2020) studied Evaluating CCPM method versus CPM in multiple petrochemical projects. Although project management has long been under consideration and various methods have been proposed for timing projects, but they have not been completely responsive to the needs of the project for increasing productivity and customer satisfaction. As a result, increased risks and the incompatibility of the project with the initial Base line plan, necessitate using modern techniques (such as CCPM) as opposed to common methods (such as CPM).

Soleymanpour *et al.* (2020) studied Mathematical modeling for the location-allocation problem - allocation of mobile operator subscribers' affairs' agencies under uncertainty conditions. Mobile phone is one of the inventions of the twentieth century that no one could have imagined that it will grow and become a profitable and huge industry in the world. In fact, mobile operators provide access to telecommunications services for users. Taghipour and Azarian. (2020) studied The Impact of Extensive Quality Management on Human Relations (Case Study: Education). The results showed a the implementation of TQM can improve the quality of relationships in the organization and make stronger relationships among the employees. Taghipour *et al.* (2020) studied Application of Cloud Computing in System Management in Order to Control the Process. The implementation and maintenance of organizational resources planning systems is really costly for each business. Large business institutes can pay the costs of organizational systems but due to high costs, small to medium businesses prefer the purchase of these systems and their relevant implementation. Cloud has some advantages in comparison to traditional data centers. Taghipour *et al.* (2015) studied Evaluation of Tourist Attractions in Borujerd County with Emphasis on Development of New Markets by Using Topsis Model. This research aims to identify tourist attractions in Borujerd County in order to develop new tourism markets in Lorestan province of Iran. For that purpose and with the use of GIS, parameters such as slope, aspect, elevation, precipitation, land use, topography, and landform geology are separately studied and digital maps for each feature are created. These activities have been analyzed using TOPSIS multi-criteria decision model and based on marketing factors. Abdollahzadeh & Taghipour (2015) studied Identify and Priorize Suitable Area for Ecotourism Development using Multi-criteria Analysis for Development of the Tourism Market in Iran (Nathanz City). Nathanz city having regard to natural attraction, desert, Karkas mountain, geo sites, protected areas have great potential to develop eco-tourism. The development of tourism in the city requires recognition of the potential and actual potential of the region. The aim of this study is to identify attractions of Nathanz city to develop new markets by using geographic information system. TOPSIS model were prioritized according to the marketing indicators.

Mirzaie *et al.* (2015) studied The Relationship Between Social Bearing Capacities with Conflict as a Result, in the Perception of the Visiting Historical Sites. Sustainable tourism needs to prevent the destruction and degradation of social, cultural and ecological systems in the host society. It is obvious that tourism development and social characteristics is changing. But this, and severity of these changes depend on the size and number of tourism activities.

Abdi *et al.* (2018) studied the relationship between strategic planning with entrepreneurial marketing in the saderat bank of north tehran. Data analysis using SPSS software showed a significant correlation between strategic planning and the four components of

entrepreneurial marketing, including consumer awareness, consumer-oriented innovation, value creation, and risk management.

Abbasi & Taghipour, (2015) studied An Ant Colony Algorithm for Solving Bi-Criteria Network Flow Problems in Dynamic Networks. The present study tries to focus on the problem of finding the maximum flow along with the shortest path in a dynamic network that this type of the network is presented in. For solving bi-criteria network problems, a two-phased exact algorithm and an ant colony (ACO) algorithm based on bi-criteria are used, where the two-phased exact algorithm is presented by Abbasi *et al.* and the bi-criteria ant colony algorithm is presented by Ghoseiri *et al.*. The computational results for 33 random instances showed that, the CPU time of the ACO algorithm has exponential growth comparing to the two-phased complete enumeration algorithm.

Sedaghatmanesh and Taghipour (2015) studied Reduction of Losses and Capacity Release of Distribution System by Distributed Production Systems of Combined Heat and Power by Graph Methods. Formulation of long term program of optimization of energy sector has positive effect on economy of country and improving the role of Iran in global energy markets. One of the results of optimization of energy supply sector is improvement of efficiency and reduction of environmental pollutants of energy generation.

Taghipour *et al.* (2015) studied A Survey of BPL Technology and Feasibility of Its Application in Iran (Gilan Province). Recently Broadband over power lines (BPL) has received much attention in communication technology and this is due to economically of sending high data rate services by re-use of power line cables. As data transfer via power lines to final consumer is one of the growing technologies, this study discusses the modeling and optimization of data transfer via power transfer lines and feasibility and adaptation of using this technology in Gilan are investigated.

Seddigh Marvasti *et al.* (2015) studied Assessing the Effect of FRP System on Compressive and Shear Bending Strength of Concrete Elements. Behavior of reinforced concrete structure depends on correct behavior of beam and column so much. Access to necessary bending strength, prevention of changing permanent configuration and prevention of bending failure of section cause to pay attention making resistant of concrete elements specially bearing beams of structures.

Jalili *et al.* (2015) studied Utopia is considered to be the physical form of an ideal human society where the goals are met. Rab-e Rashidi is one of the Islamic utopia that has practically manifested and this view on ideal city in today's modern urbanization can be received based on the perspectives of Kevin Lynch. The results demonstrate the social justice, attention to infrastructure, dynamics in physical aspects of the city, mental image and climate considerations concepts which promote the quality of life in Rab-e Rashidi. Finally Rab-e Rashidi can be a comprehensive model of Islamic utopia for designing modern cities.

Khodakhah Jeedi *et al.* (2016) studied The Analysis of Effect Colour Psychology on Environmental Graphic in Childeren Ward at Medical Centers. The hospitals are some of architectural spaces, which are assumed as important in terms of design and function due to giving medical services and referrals of various groups of people.

Taghipour *et al.* (2018) discussed Insurance Performance Evaluation Using Bsc-Ahp Combined Technique. One of the most effective practices used by organizations is the use of performance evaluation in order to determine weaknesses and strengths of organizations and

fix them and enhance their strengths. Performance management and evaluation play a prominent role in determining and implementing strategies, as well as contributing to organizations' competition power. In this regard, possessing a model for evaluating organization's strategic performance seems essential. One of the techniques is the balanced scorecard which was introduced to evaluate organizations' performance for the first time and is still recognized as a method of strategic planning which can be applicable. The balanced scorecard is a managerial concept which helps managers at all levels controls their key activities. In this research, we aim to assess the performance of various representatives of Kosar Insurance Co. in Qazvin using a combined approach, the balanced scorecard (BSC) and analytical hierarchy process (AHP), and prioritize them and explore their strengths and weaknesses.

Rezvani Befrouie A *et al.* (2015) discussed the design of high-rise building with ecological approach in Iran (Alborz Province). The present study aimed to evaluate the ecological architecture with the concept of increasing energy storage, reduction of fossil energy, reduction of CO2 emission and replacing clean energy. This study aimed to minimize the need of high-rise buildings to fossil fuels, achieving. The results showed that by curve form (oval) for the lowest aspect in east and west and extension in eastern and western (aerodynamic), we can use renewable and clean energy in high-rise buildings in Alborz (Azimie). Also, by solar space (Atrium), we can minimize energy consumption in high-rise buildings in Alborz (Azimie).

Torabi *et al.* (2015) studied Implementation of hierarchy production planning model and its theoretical comparison with manufacturing resources planning (MRP II) (Case study of Iran Khodro Company).

Now, the companies and institutions view production management and manufacturing planning systems as one of the aspects raising important competitive advantage for them. This causes that we observe the mentions and new systems in this field. Hierarchy production planning (HPP) is raised as one of the methods. In the past decades, considerable studies have been conducted in this regard. This study attempted to adjust Meibody model of existing models in manufacturing hierarchy.

Taghipour *et al.* (2020) studied Investigating the Relationship between Competitive Strategies and Corporates Performance. The purpose of this study was to investigate the relationship between competitive strategies and corporates performance. Statistical population of research was consisted active experts and specialists in Parsian Bank in Tehran. The results of this research showed that the relationship between competitive strategies and corporates performance among active experts and specialists in Parsian Bank approved.

Taghipour *et al.* (2020) studied The identification and prioritization of effective indices on optimal implementation of customer relationship management using TOPSIS, AHP methods. One of the reasons of failure of customer relationship management is the lack of suitable criteria to evaluate customer relationship management. A comprehensive measure to assess customer relationship is necessary from a systematic view. The present study aims to evaluate and prioritize effective factors on optimal implementation of customer relationship management in Pasargad bank using statistical methods. The present study evaluates and prioritize the effective factors on optimal implementation of customer relationship management using MADM methods. The results also can be used in the required population and it is an applied design.

Taghipour and Yadi (2015) studied Seismic Analysis (Non-Linear Static Analysis (Pushover) and Nonlinear Dynamic) on Cable-Stayed Bridge. Pushover analysis application development is greatly increased in recent years and numerous advanced methods to evaluate the seismic pushover are provided. Because these methods have been proposed mainly for building structures and given the fundamental differences between the behavior of bridge structures and buildings using pushover methods on the bridge structure with the uncertainties faced. Thus a pushover analysis is presented for evaluation of seismic bridge pylons and deck where the effects of displacement and deformation of the plastic joints, structural changes in the modal characteristics of change used plastic forms and effects of higher modes can be seen clearly.

Taghipour and Moosavi (2020) studied A look at Gas Turbine Vibration Condition Monitoring in Region 3 of Gas Transmission Operation. Study aims to investigate vibration monitoring status in region three of gas transmission operation in Iran. For this purpose, the vibration condition monitoring systems in a gas compression station have been studied. The number and location of vibration sensors, vibration signal transmission to the control room, alarm and stop command, and the ability to perform advanced vibration analysis for troubleshooting and data storage are taken into consideration.

The study of location was started since 1909 with the study of Weber on location of a source to minimize the distance and number of applicants (Weber, 1929). The studies of Hakimi (1964) were continued to locate site selection in communication network and police stations in the roads. In the mid 1960s, location was studied. Most of the basic issues of sources location selection are formulated as stationary and dynamic (Owen, 1998:423-447). Pallenberg (2002) believes that stable location of industrial parks is the result of the change in location and the government goals to coordinate the economic and environmental dimensions. He believes that for location of industrial parks, besides consideration traditional location factors, it is required to consider collaboration and trust between enterprises, respecting the profit of other enterprises, political support of government and suitable supervision to guarantee the environmental goals. The first and most important step in establishing industrial parks is based on environment features, interest of enterprises to be present in such parks and observing rules as voluntarily. Massachusetts University (2006) evaluated industrial parks in Franklin (e.g. Greenfield Site, Turners Falls Airport, Northeast Utilities Site and Northfield Site). Evaluation criteria in this study include general criteria (e.g. topography, type of soil, archeology issues, zoning and extension of park), environmental criteria (existing environmental rules at national and regional level), and infrastructures (e.g. urban water supply and underground water tables, sewage system, access to Road, natural gas, access to high speed internet), transportation (access to highway and Rail and aerial lines). After data collection and defining weaknesses and strengths, some recommendations are presented. The results of study show that as greenfield is a mineral region, it is not suitable to establish industrial park. Also, this region requires natural gas and high speed internet lines and we should think about the slope of the region higher than 12%. As Turner has no infrastructural facilities with low area, it is required to perform economic studies. Utilities Site requires sewage and internet. Northfield needs water and waste water supply and as there are agriculture activities in this region, re-zoning is required.

Ruiz (2007) in a study to locate industrial parks introduced social, economic, environmental, planning and infrastructural criteria and by GIS defined the best location for industrial parks in the north of Spain.

Fernandez (2009) in a study considered social, economic, planning and environmental factors effective on location of industrial parks and by AHP model showed that environmental and economic factors with the weights 50, 30%, respectively were the most important factors on location of industrial parks in Cantabria in the north of Spain. The results of his study showed that among economic, social, planning and environmental factors, unemployment rate, industrial activities in the region, environment management and environment improvement, urban planning management, transportation, water and wastewater were the most important factors on location of parks.

Ruiz, *et al.*, (2011) evaluated suitable regions in the north of Spain. They performed location in two stages. The first stage includes an extended area. The effective factors on location of enterprises include socio-economic, local physical, infrastructural and urban. Access to resources, infrastructures and special costs are effective factors on location in second stage. The results of study show that among economic, social, physical, infrastructural and urban development factors, land price, unemployment rate, transportation and zoning are the most important factors on location of industrial parks. Among the important criteria, infrastructures and urban development with the weight 53% are the most important factors on location of industrial parks in Spain. Aleksandar *et al.*, (2013) in a study "GIS Based Multi-Criteria Analysis for Industrial Site Selection" stated that selection of industrial complex one of the basic decisions in the start of process, development or movement of trades. Construction of a new industrial system is an important and long-term investment as region selection is an important point in success or failure of an industrial system. One of the important goals in selection of Industrial Park is finding the best location based on the conditions determined by selective criteria. The majority of information is used by managers and decision makers in selection of industrial park location as geographical information. It means that the process of site selection of an industrial park is a difficult decision.

In this paper, geographical information system is used in connection with systems and other methods as some systems for decision making and a method for multiple criteria decision making. The effect of collaboration between these systems is achieved by combination of these tools for quality of spatial evaluation to select industrial park place. This paper is a good solution to help the decision making in the region selection about selection of Vojvodina as a useful region for Industrial Park. Dana, K, Alexander, K, (2014) in a study "Analysis of macroeconomic factors for the establishment of industrial parks and their effects on regional development" stated that this study aimed to evaluate key factors of macro economy, the effect of founder of parks on industrial parks with positive effect on development of a good region in Slovakia as EU member and Europe. There is dependence relationship between regional growth factors, investment and investment value to establish industrial complex and its effects on regional development by statistical variables during 2001-2011 and the linear statistical models are evaluated to achieve real macro-economic development in Slovakia. Thus, important regional factors are supportive management and establishment of industrial parks in Slovakia as condition of direct foreign investment, employment, financial support of state, investors, marketing strategy to absorb investors, full capability of industrial region based on positive regional effects, per capita GDP regarding reduction of unemployment growth. According to the results, important regional factors can be used in management of establishing industrial parks in EU countries based on a consistency between dependent economy and common relations.

Questions and purpose of study

- 1- Which place is suitable to establish a specialized complex producing a special product?
- 2- Which special features does a suitable place have compared to other regions?

This study aims to present a good place to establish a specialized product complex and achieve local markets or finally for a serious presence in Persian Gulf region.

Based on the feasibility studies and location of development plan of this product, "Teksa Beinolmel Mehr" company is the beneficiary of this study and this study is also applied.

Introduction of study method and model

As our country has 7 free zones and 34 special zones, the opinion of 10 experts in basic planning and macro decision making of company is used. 90% of the sample members are men and 100% above 30 years old, 90% with BA and above and 60% with work experience higher than 10 years. Also, the structure of the above model is as shown in Figure (1).

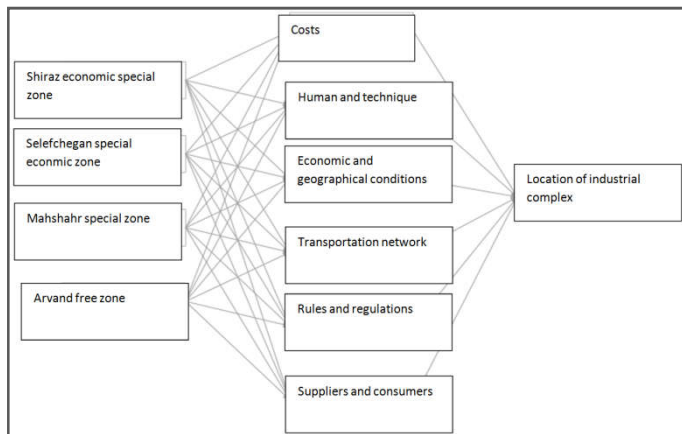


Figure 1. The hierarchy structure of criteria and candidate sites to establish industrial complex

The data collection stages; For data collection, library and field methods are used. For review of literature, library method, journals, different scientific bases on internet are used. The main data of study are collected by field method, questionnaire and interview. In the first stage, to have mastery of study topic and extract of location of specialized complex, library method including the study of papers, reports, books and documents are used. By the interview with the experts, the criteria of review of literature are evaluated and finally the required criteria select the experts. In the second stage, after the collection of criteria of location of specialized complex by pairwise comparison Tables, the experts opinion of the company regarding the relative importance of criteria is asked. Based on the combination of AHP, VIKOR methods, we have two pairwise comparison Tables and one of them is asked about the intensity of the effect of criteria on each other and in another Table, relative importance of criteria to each other is asked.

At first, the experts are asked to define the importance of indices based on spectrum 1(low importance) to 10(vital importance) or present the index or indices not in the model. By presenting an instruction to complete questionnaire, filling out the questionnaire is trained to the participants and the researcher is present during this process. In the fourth stage, after achieving relative weight of criteria from the previous stage, location of specialized complex is performed by pairwise comparison Tables.

The choices and criteria: During the initial studies, the possible choices including three special zones of Shiraz, Salafchegan, Mahshahr and free zone Arvand are defined by the main decision makers.

To identify the effective factors on selection of the location of industrial complex, some studies have been performed on effective factors on location of industrial unit and interviews are made to receive the opinion of experts and the results include the following criteria:

Costs of land purchase, construction costs, raw materials cost, raw materials transfer costs, transfer costs of sold goods, wage rate, land leveling costs, fuel costs, water and power costs, legal exemption and loans of government, availability of skillful labor, availability of non-skillful labor, reliability on labor, weather condition, availability to fuel resources, access to university and educational institutes, technical knowledge in the region, living conditions, disposal of industrial waste, potential of industrial development of the region in future, proximity to relevant industries, industrial experience of the region, geographical conditions of the region, economic conditions, access to road and highway, access to Railway, access to airport, access to port, raw materials in the region, reliability of providing raw materials from the outside and inside of the region, access to pre-fabricated parts, access to the main suppliers, access to the main consumers, expectations to develop market and export in future, the place of competitors and creating good competitive conditions, distance to the local market, distance to the present export border, sale, tax rate in the region, rules of pollution and environmental rules, insurance and indemnity rules.

Reduction and classification of criteria: To simplify the implementation of decision making methods, important and unimportant criteria are identified and by elimination of low important criteria, the number of criteria is reduced. In the next stage, to reduce the number of criteria in the main matrix of decision, important criteria are classified as:

1. Costs criteria
2. Human and technique
3. Economic and geographical conditions
4. Transportation network
5. Suppliers and consumers
6. Rules

Fuzzy multiple decision making techniques

FAHP method: The main idea of AHP is receiving the knowledge of experts regarding the studied phenomenon. But the classic AHP can not reflect cognitive process of human being namely under conditions in which issues are not defined well or solving these issues includes unreliable data (Haghighi *et al.*, 2010: 4084–4093). This study applies fuzzy hierarchy analysis process of Chang (Chang, 1996: 649-65). In fuzzy AHP technique, after drawing decision hierarchy tree, the pairwise comparison of elements is performed. In calculation stage, by definitions of fuzzy AHP, the coefficients of each of pairwise comparison matrices are computed (Azar, 2002). For each of rows of pairwise comparison matrices, S_k value as a triangular fuzzy value of Equation (1) is used and to compute each of sections of this equation, Equations (2), (3), (4) are used:

$$S_k = \sum_{j=0}^n M_{Ki}^j \otimes [\sum_{i=0}^m \sum_{j=1}^n M_{ij}]^{-1} \quad (1)$$

$$\sum_{j=1}^m M_{ij} = (\sum_{i=1}^m l_j, \sum_{i=1}^m m_j, \sum_{i=1}^m u_j) \quad i = 1, 2, \dots, m \quad (2)$$

$$\sum_{i=1}^m \sum_{j=1}^n M_{ij} = (\sum_i^n l_i, \sum_i^n m_i, \sum_i^n u_i) \tag{3}$$

$$[\sum_{i=1}^n \sum_{j=1}^m M_{Kij}^j]^{-1} = \left[\frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i} \right] \tag{4}$$

After calculation of all S_K s, in this stage, the magnitude degree of each of elements on other elements is computed separately:

$$\begin{cases} V(M_1 \geq M_2) = 1 & \text{if } m_1 \geq m_2 \\ V(M_1 \geq M_2) = 0 & \text{if } l_2 \geq u_1 \\ V(M_1 \geq M_2) = hgt(M_1 \cap M_2) & \text{otherwise} \end{cases} \tag{5}$$

$$hgt(M_1 \cap M_2) = \frac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)} \tag{6}$$

The magnitudes of a triangular fuzzy value, k triangular fuzzy value of the following equations are achieved:

$$V(M_1 \geq M_2, \dots, M_K) = V(M_1 \geq M_2) \text{ and } \dots \text{ and } V(M_1 \geq M_K) \tag{7}$$

To calculate the weight of indices in pairwise comparison matrix, we act as:

$$W'(x_i) = \text{Min}\{V(S_i \geq S_K)\} \tag{8}$$

K=1,2,...,n, k≠i

Thus, the vector of weight of indices is as followings and it is fuzzy AHP abnormal coefficients:

$$W' = [W'(x_1), W'(x_2), \dots, W'(x_n)]^t \tag{9}$$

FVIKOR method: Fvikor method was introduced by Opricovic (1998). It is an important measure in multiple decisions making and is used in solving quantitative problems with inconsistency indices. The inconsistency of criteria is as sometimes they are contradictory, for example if a person buys a pretty car should pay more and the criteria of costs are in contradiction to the criteria of beauty (Momeni, 2006). This method is used under conditions in which the decision maker cannot express his preferences at the beginning of system design. In this method, a decision maker is required to have a solution and this solution is the closest solution to ideal solution. If in a multiple criteria decision making, there are m criteria and n choices, to select the best choice by this method, the method stages are as follows (Pellenbarg, 2002: 59-84).

Decision matrix formation: Based on the number of criteria, the number of choices and evaluation of all choice for different criteria, decision matrix is as follows:

Where, X_{ij} is the performance of jth choice (j=1,2,...,n) in relationship with ith criterion(i=1,2,...,m) .

Determine matrix of weight of criteria : In this stage, based on the importance coefficient of different criteria in decision making, a matrix is defined as:

$$W = [W_1, W_2, \dots, W_m] \tag{10}$$

In this study, FAHP method is applied.

Determine the best and the worst value among the existing values for each criterion in decision making matrix as F_i^* is the best value of ith criterion among all choices and F_i^- is the worst ith value among all choices.

The calculation of S,R values: S,R values are computed based on the following Equations and W_i is the required weight for ith criterion.

$$S_j = \sum_{i=0}^n W_i \left[\frac{f_i^* - f_{ij}}{f_i^* - f_i^-} \right] \tag{11}$$

$$R_j = \text{Max } W_i \left[\frac{f_i^* - f_{ij}}{f_i^* - f_i^-} \right] \tag{12}$$

Where, S_j indicates the distance of jth choice from the positive ideal and R_j indicates the distance of jth from negative ideal choice. The best rank based on S_j value is the worst rank based on R_j value.

Calculation of Q value

$$Q_i = (\nu) \left[\frac{S_i - S^*}{S^- - S^*} \right] + (1 - \nu) \left[\frac{R_i - R^*}{R^- - R^*} \right] \tag{13}$$

$$R^* = \text{Min } R_j, S^* = \text{Min } S_j, \bar{R} = \text{Max } R_j, \bar{S} = \text{Max } S_j$$

ν is the weight of majority strategy of criterion or maximum group suitability:

$\left[\frac{S_i - S^*}{S^- - S^*} \right]$ indicates distance from negative ideal of choice ith and majority agreement for ith ratio.

$\left[\frac{R_i - R^*}{R^- - R^*} \right]$ indicates the distance from ideal solution of choice ith and means disagreement with choice ith. If ν is bigger than 0.5, Q_i index leads to the majority agreed. If the value is lower than 0.5, Q_i index indicates negative attitude of the majority. When ν is 0.5, it indicates agreed attitude of evaluation experts.

In this study, ν is equal to 0.5.

Ranking choices based on VIKOR method: The choices are compared based on one of the methods of project control and area. It is recommended to use area method as in this case, the choices are compared two by two. If we have n choices, we have $\binom{n}{2}$.

In this study, area method is used.

RESULTS ANALYSIS

The verbal statements of respondents in criteria and places can be converted to triangular fuzzy values (Lee, 2010; Yang &Hsieh, 2009, 2010). The verbal scales to determine weight of criteria are as shown in Table 1 .

Table 1. The fuzzy value and linguistic scale to determine the weight of criteria

Linguistic number	Very low (VL)	Low (L)	Medical low (ML)	High (H)	Very high (VH)
Triangular fuzzy number	(1,1,1)	(1,3,5)	(3,5,7)	(5,7,9)	(7,9,11)

Also, verbal scale to prioritize the establishment of complex is shown in Table 2 .

Table 2. The fuzzy number and linguistic scale to prioritize the places

Linguistic number	Worst (W)	Poor (P)	(F) Fair	Good (G)	(B) Best
Triangular fuzzy number	(0,0,2/5)	(0,2/5,5)	(2/5,5,7/5)	(5,7/5,10)	(7/5,10,10)

As it was said before, weighting to criteria is based on group FAHP and it is performed based on analysis method of Chang. Thus, of the geometry mean of 10 questionnaires achieved by fuzzy triangular matrix of pairwise comparison, the matrix of aggregation of experts' opinion is used in Table (3).

Then, the extension of fuzzy compound is computed as:

$$C_1 = (4.584, 5.959, 8.65),$$

$$C_2 = (4.82, 7.511, 11.25),$$

$$C_3 = (3.911, 5.76, 8.27),$$

$$C_4 = (3.02, 4.05, 5.7)$$

$$C_5 = (10.23, 15.5, 20.83),$$

$$C_6 = (6.7, 9.75, 14.41)$$

$$SC_1 = (0.64, 0.137, 0.259),$$

$$SC_2 = (0.067, 0.172, 0.337),$$

$$SC_3 = (0.054, 0.132, 0.248)$$

$$SC_4 = (0.042, 0.093, 0.171),$$

$$SC_5 = (0.143, 0.356, 0.624),$$

$$SC_6 = (0.093, 0.224, 0.432)$$

$$\sum \sum M^j = (33.264, 42.77, 69.11)$$

$$\left[\sum \sum M^j \right]^{-1} = \left(\frac{1}{69.11}, \frac{1}{42.77}, \frac{1}{33.264} \right) = (0.014, 0.023, 0.03)$$

After achieving fuzzy compound extension, possibility degree of each paired is computed as shown in Table 4 and minimum possibility degree of each of criteria to other criteria is achieved to achieve weight vector of location criteria of specialized complex as shown in Table 5.

Table 3. The matrix of aggregation of experts opinion

	Costs			Human and technique			Economic and geography			Transportation			Rules			Suppliers and consumers		
Costs	1	1	1	0.614	0.919	1.34	1.62	2.14	3.15	1	1.43	2.4	0.21	0.27	0.38	0.14	0.2	0.38
Human and technique	0.74	1.08	1.62	1	1	1	0.53	0.88	1.31	1.52	2.54	4.3	0.28	0.411	0.62	0.75	1.6	2.4
Economic and geography	0.3	0.46	0.61	0.75	1.13	1.88	1	1	1	1.2	2.1	3.2	0.2	0.27	0.38	0.46	0.8	1.2
Transportation	0.41	0.7	1	0.23	0.39	0.65	0.31	0.46	0.82	1	1	1	0.7	1	1.43	0.37	0.5	0.8
Rules	2.6	3.6	4.5	1.6	2.4	3.4	2.6	3.6	4.5	0.71	1	1.43	1	1	1	1.73	3.9	6
Suppliers and consumers	2.6	4.7	6.8	0.4	0.6	1.31	0.8	1.2	2.1	1.2	2	2.6	0.7	0.25	0.6	1	1	1

Table 4. The possibility degree for each paired of criteria

$V(S_1 \geq S_2) = 0.845$	$V(S_1 \geq S_3) = 1$	$V(S_1 \geq S_4) = 1$	$V(S_1 \geq S_5) = 0.346$	$V(S_1 \geq S_6) = 0.656$
$V(S_2 \geq S_1) = 1$	$V(S_2 \geq S_3) = 1$	$V(S_2 \geq S_4) = 1$	$V(S_2 \geq S_5) = 0.513$	$V(S_2 \geq S_6) = 0.052$
$V(S_3 \geq S_1) = 0.097$	$V(S_3 \geq S_2) = 0.819$	$V(S_3 \geq S_4) = 1$	$V(S_3 \geq S_5) = 0.319$	$V(S_3 \geq S_6) = 0.627$
$V(S_4 \geq S_1) = 0.708$	$V(S_4 \geq S_2) = 0.481$	$V(S_4 \geq S_3) = 0.75$	$V(S_4 \geq S_5) = 0.096$	$V(S_4 \geq S_6) = 0.037$
$V(S_5 \geq S_1) = 1$	$V(S_5 \geq S_2) = 1$	$V(S_5 \geq S_3) = 1$	$V(S_5 \geq S_4) = 1$	$V(S_5 \geq S_6) = 1$
$V(S_6 \geq S_1) = 1$	$V(S_6 \geq S_2) = 1$	$V(S_6 \geq S_3) = 1$	$V(S_6 \geq S_4) = 1$	$V(S_6 \geq S_5) = 0.686$

Table 5. The final weight of criteria

	Costs	Human and technique	Economic and geography	Transportation	Rules	Suppliers and consumers
Minimum possibility degree	0.346	0.052	0.097	0.037	1	0.686
Final weight of criteria	0.155	0.023	0.043	0.016	0.45	0.309

To determine priority of places to establish complex, FVIKOR method and fuzzy numbers of Table 2 are used. The matrix of experts' opinion is shown in Table 6.

Table 6. Matrix of expert's opinion

Matrix of experts opinion	Costs			Human and technique			Economic and geography			Transportation			Rules			Suppliers and consumers		
	Expert 1	Expert 2	...	Expert 1	Expert 2	...	Expert 1	Expert 2	...	Expert 1	Expert 2	...	Expert 1	Expert 2	...	Expert 1	Expert 2	...
Shiraz special zone	G	G	...	B	G	...	G	G	...	G	F	...	G	F	...	B	G	...
Salafchegan special zone	G	G	...	G	P	...	G	G	...	G	F	...	G	F	...	F	G	...
Mahshahr special zone	P	P	...	P	P	...	P	P	...	G	G	...	G	F	...	P	P	...
Arvand special zone	P	P	...	P	P	...	P	P	...	P	G	...	P	F	...	F	P	...

Normal matrix of collection of opinion of experts based on the information of previous Table is shown in Table 7:

	Costs			Human and technique			Economic and geography			Transportation			Rules			Suppliers and consumers		
Weight	0.155			0.023			0.043			0.016			0.450			0.309		
Shiraz e	0.500	0.310	0.290	0.570	0.350	0.290	0.450	0.320	0.280	0.290	0.250	0.270	0.450	0.270	0.260	0.560	0.350	0.300
Salafchegan	0.500	0.310	0.290	0.430	0.290	0.270	0.540	0.360	0.290	0.290	0.250	0.260	0.540	0.300	0.280	0.430	0.290	0.280
Mahshahr	0.000	0.180	0.200	0.000	0.170	0.230	0.000	0.170	0.220	0.140	0.310	0.310	0.000	0.190	0.240	0.000	0.140	0.170
Arvand	0.000	0.180	0.200	0.000	0.170	0.190	0.000	0.140	0.180	0.000	0.180	0.310	0.000	0.210	0.200	0.000	0.220	0.230

The continuance of stages and FVIKOR technique steps is shown in Table 8-11.

Table 8. The best and the worst fuzzy value

	Costs			Human and technique			Economic and geography			Transportation			Rules			Suppliers and consumers		
Fi+	0.50	0.31	0.29	0.57	0.35	0.29	0.54	0.36	0.29	0.31	0.31	0.54	0.30	0.28	0.56	0.35	0.30	
Fi-	0.00	0.18	0.20	0.00	0.17	0.19	0.00	0.14	0.18	0.00	0.18	0.26	0.19	0.20	0.00	0.14	0.17	

Table 9. S_i, R_i values

S ₁	-0.699	0.204	3.275	R ₁	0.000	0.123	2.641
S ₂	-0.722	0.103	0.865	R ₂	0.001	0.088	0.418
S ₃	0.800	0.974	1.209	R ₃	0.371	0.450	0.482
S ₄	1.111	0.796	1.776	R ₄	0.371	0.368	0.546

Table 10- The best and worst S_i, R_i values

S*	-0.722	0.103	0.865	R*	0.000	0.088	0.418
S-	1.111	0.974	3.275	R-	0.371	0.450	2.641

Table 11- Prioritization of places

Q1	-31.108	0.106	12.532
Q2	-7.640	0.000	7.632
Q3	-5.230	1.000	4.422
Q4	-5.746	0.785	5.572

S_{total}	29.456	S_1	10.033	S_2	19.423
S_{total}	26.646	S_1	8.455	S_2	18.191
S_{total}	26.646	S_1	8.455	S_2	18.191
S_{total}	12.461	S_1	5.967	S_2	6.495
S_{total}	13.295	S_1	6.318	S_2	6.977
S_{total}	10.485	S_1	4.978	S_2	5.506
Q2 > Q1					
Q3 > Q1					
Q4 > Q1					
Q3 > Q2					
Q4 > Q2					
Q4 > Q3					

Thus,
 $Q4 > Q3 > Q2 > Q1$

Conclusion and Recommendation

he initial view of each study is achieving practical results. Thus, the researcher gets all methods to achieve a good result. We can use the results to direct the study design. Generally, this stage of study is of great importance for some reasons:

- All results are defined in this section.
- This section is a summary of findings and ideas of total scientific process of study.
- Conclusion section completes other study sections as if it is suitable, it enriches other previous stages and probable weaknesses are covered (Garmsir, 2014).

By defining the model of study, definitions and concepts of study topic and history of measurements to locate industrial complexes in the world, the data are collected. Based on the theoretical basics, the study is descriptive analytic and is evaluated in the form of hypothesis.

Generally, in these studies, formulation of indices and criteria is a basic issue. In the first step, the indices and components of location of industrial complex are extracted. These indices have not similar weight and importance and ranking of these criteria is done by FAHP method.

By defining the weight and rank of each criterion, candidate places to establish industrial complex by FVIKOR method are evaluated.

The basis of any study is hypotheses and questions as the basic condition to achieve purpose of study is moving toward the framework of hypotheses and achieving the answers of questions. The present study is not an exception. To do the study, an assumption is selected and the required evaluations are performed. By data analysis and results, we can answer the study questions:

First question

Which place is suitable to establish a specialized complex producing a special product?

Based on the data received from VIKOR method, the best place to establish complex is special zone of Shiraz, then special zone of Salafchegan, Mahshahr and free zone of Arvand. According to Jafar Ghaderi, representative of Shiraz people in Islamic council parliament, after the trip of Dr. Jahangiri and Dr. Nobakht, first deputy and planning deputy of the president in Fars province, the idea of joining industrial park of Shiraz to special zone of Shiraz was raised. He added, as big industrial park of Shiraz is on the proximity to special zone of Shiraz, this region has good weather condition in Shiraz compared to special zones beside the borders of country and as it is close to a big city as Shiraz, it can absorb more industries with new and high technologies compared to border special zones. We should use the capacity of special zone of Shiraz to develop the capabilities of industries located in great industrial park of Shiraz. If we manage this joining process well, the authorities of special economic zone and industrial park of Shiraz, this is done easily and besides the increase of benefits of industrial units in both units, the benefits of both organizations are increased. The reduction of administrative costs, establishment of specialized customs sectors in special zone and increase of rank of special zone of Shiraz among special zones and absorption of more investors are the advantages of the joining process of this special zone. Reduction of administrative costs, welcoming of investors and using benefits of special zones are the advantages for the industrial park organization to be joined to the economic special zone of Shiraz. Also, in the mentioned session, the idea of converging the special zone to free zone was raised and this idea had many positive points.

Second question:

What are the best features of a good place compared to other regions?

Based on FAHP method and final weight of rules method with final weight 0.45, has the highest effect on selection of a good site. Then, suppliers and consumers with the final weight 0.309, costs with final weight 0.155, economic and geographical with final weight 0.043, human and technique with final weight 0.023 and transportation with final weight 0.016, respectively are important criteria in selection of the place to establish a specialized complex.

	Costs	Human and technique	Economic and geographical	Transportation	Rules	Suppliers and consumers
Minimum possibility degree	0.346	0.052	0.097	0.037	1	0.686
Final weight of criteria	0.155	0.023	0.043	0.016	0.45	0.309

The applied recommendations

The present study is performed with the order of the project client and special industrial center. To locate other industrial centers, the above criteria are preferred and above areas are considered and they can use the results of study.

Suggestions for further studies

- In this study, only 4 places are selected to establish specialized complex. In further studies, the researcher can increase these places and evaluate at special and free zone areas.
- In this study, the combination of FAHP, FVIKOR methods is used. In further studies, the researcher can evaluate other methods or compare them with each other.

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