Proposing an indigenous sustainable methodology for evaluating the effectiveness of industrial parks: A real-life application in Iran

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Abstract

The goal of this research is to develop a hybrid methodology consisting of qualitative and quantitative approaches to find the factors that significantly affect the effectiveness of industrial parks of Iran. Through using this methodology, the impacts of the detected factors are analyzed. The methodology seeks to direct Iran's industrial parks to sustainable development; hence, the factors include sustainability-related elements as well. For the qualitative approach, the literature has been scrutinized and with the help of practitioners in focus groups, some of the most important factors influencing the effectiveness of industrial parks have been discovered. Three of the discovered factors investigate the impact of sustainability on the effectiveness of industrial parks. For the quantitative approach, a reliable questionnaire has been designed which asked the importance of the identified factors from a community of experts. Having acquired the viewpoints of the experts, the Structural Equation Modeling (SEM), with the help of the Confirmatory Factor Analysis (CFA), has been applied to investigate the relations between the factors and the effectiveness of parks. Reliability of the designed questionnaire has been tested by the Cronbach's alpha coefficient. Results of the developed model have been thoroughly analyzed by means of diverse performance measures. According to the outputs, the factors "accessibility to infrastructural facilities", "economic elements", and "existence of supporting services" had the highest impact on the effectiveness of Iran's parks. On the opposite, the "environmental elements" had the least influence on the parks of Iran. This fact implies that the environmental degradations should be considered more seriously for Iran's industries on the path of sustainable development. The convergent and discriminant validity of the proposed model have been demonstrated and approved via several performance evaluation metrics. The proposed model has been applied to provinces of Iran. An overall effectiveness score has been computed for each province. The provinces have been sorted based on their effectiveness scores.

1. Introduction

1.1. Industrial parks and their effectiveness

One of the prominent ways to achieve local and regional development is through development of industries in a country. Through industrial development, developing countries in East Asia have experienced economic growth and they have been able to compete in world markets. On the opposite, the least developed countries which suffer from rudimentary and non-dynamic industries have to produce a limited spectrum of simple products which result in trivial impacts on their economic growth (Lall, 1991). Establishing industrial parks can be effective on thriving industrial development of countries since they provide sufficient infrastructure and services; hence, artisans and investors are attracted to these industrial areas to set up their companies (Hu et al. 2009). To benefit from the economic advantages obtaining from industrial parks, many countries worldwide were attracted to creation of industrial districts, where their industries can thrive and experience development by using the provided services. Consequently, in recent years, there has been a surge in the number of industrial parks established around the world (Yang et al. 2018). An industrial park is an area established with the goal of creating wealth and jobs for a specific region with a sustainable perspective. The companies that reside in an industrial park present a wide range of services such as consultations, designing or engineering, trading, manufacturing, etc. Existence of efficient industrial parks which provide supporting services for investors can result in growth of industries; therefore, industrial development of a country will be more likely to be achieved. Establishment of industrial parks may have several advantages that lead to the following outcomes: (1) Establishment cost of infrastructural facilities is minimized, (2) Investors are persuaded to partake in production activities, (3) Value-generating and income-producing jobs will be obtained, (4) Different industries will be brought to under-developed regions, where the potentiality of industrial development is significant, (5) Industries existing in industrial parks will have interrelationships, etc. (Geng and Hengxin, 2009).

Despite the advantages mentioned for industrial parks, there are certain challenges encountering managers and policy makers. Establishing an industrial park needs hefty investment on many requirements such as land preparation, infrastructural facilities, construction, and supporting services. Moreover, the mere establishment of an industrial park will not always lead to economic benefits. Hence, a proper performance monitoring procedure should exist to ensure the effective utilization of industrial parks (Yang et al. 2016; Yang et al. 2018). One of the prominent policies which can be applied for maximizing the economic gain from industrial parks is to construct and develop "effective" or "demand-driven" parks. Demand-driven or effective parks are industrial districts in a country, where investment motivations for private sector are significantly higher than other industrial zones. This means that many of the private industry owners tend to set up their companies or industries in these areas. Industrial parks will not become effective without certain causes; therefore, there is a necessity to develop a valid framework in order to identify the influential factors on the effectiveness of industrial parks.

1.2. Industrial parks and sustainable development

In recent years, the sustainability aspect of industrial parks has been of high concern for the governments, responsible organizations, investors, and researchers; since the industrial parks blessed with green production will have competitive benefits and superiority over the parks operating based on non-green productions. Furthermore, recent years have witnessed the focus of many governments and private industry owners on sustainable development of industries or businesses (Tudor et al., 2007; Bellantuono et al., 2017). Through sustainable industrialization, socio-economic benefits will be obtained without degrading the quality of surrounding environment (Patnaik and Poyyamoli, 2015). To satisfy the requirements for achieving sustainable industrial development, many countries (including Iran) stepped on the course of establishing Eco-Industrial Parks (EIPs) that incorporate three aspects of sustainability, namely the society, environment, and economy (Veiga and Magrini, 2009; Jung et al. 2013). An eco-industrial park embraces a set of manufacturing and service companies that collaboratively work together to relieve environmental and resource concerns so that better social, economic, and environmental performance is achieved (Cote and Cohen-Rosenthal, 1998; Veiga and Magrini, 2009). The concept of EIPs has been utilized to: (1) tackle the negative environmental impacts originating from industrial development, and (2) promote sustainable development in industrial areas. Recent years have witnessed the spread of EIP concept in both developing and industrialized countries as a tool to acquire sustainable development. Precipitous procedure of industrial development resulted in overconsumption of resources in addition to environmental issues. Therefore, the concept of EIP has been employed to relieve environmental harm and concurrently to enhance social and economic benefits. The industrial parks of Iran are no exceptions and the rivalries among the industry owners led these parks to sustainable development. However, based on the given descriptions in the previous sub-section regarding the effectiveness of parks, a crucial question faces the industrial parks of Iran on the path of sustainable development which is "How much the effectiveness of the industrial parks of Iran is affected by the sustainability-related factors?". Therefore, this study targets to present a methodology by which the influential factors on the effectiveness of industrial parks are identified. The proposed model of this study embraces the sustainability-related factors and other influential factors altogether to have a comprehensive perspective on the effectiveness of parks.

1.3. Inspiring motivations

Establishment of industrial parks in Iran has a main purpose which is providing required services and supports for non-governmental organizations and entities to set up their industries and pursue their business plans. When these non-governmental entities are established, considerable amounts of investments might be directed to the industrial parks housing the aforementioned entities. More effective industrial parks will receive more attention from artisans; therefore, more organizations will be persuaded to set up and carry on their businesses in these parks. Hence, it is essential to investigate and detect the influential factors that affect the effectiveness and demand-driven level of industrial parks. By identifying these factors, it will become possible to: (1) establish highly effective industrial parks, and (2) lead the less effective industrial parks to better performance and effectiveness. The aforementioned reasons inspired the researchers of this study to focus on detecting the influential factors. Since the sustainability of the parks has been a concern for the country, the influential factors have been detected with regard to sustainability considerations. Having focused on the demand-driven level of parks, this study can deliver helpful analyses and consultations for the responsible provincial organizations so that they can offer sufficient support and services for industrial parks; consequently, industrial development, employment rate, appropriate allocation of wealth, etc. will be achieved. In a nutshell, the general motivation of this research is to provide a framework based on which the factors and variables influencing the effectiveness of industrial parks will be identified with respect to sustainability perspective. Furthermore, the authors yearn to provide an indigenous model by which it will be possible to analyze the impact of the identified factors on the effectiveness of Iran's industrial parks.

1.4. Targets of this study

The current research tries to detect the important factors that influence the effectiveness or demand-driven level of industrial parks. More effective parks are subject to more attention and better investments from the artisans who are willing to employ the services offered by these parks to develop and promote their industries. Hence, finding the key factors leading to better effectiveness is of high importance. In detecting the influential factors, this study aims to incorporate the sustainability considerations as well. These factors have also been embraced in this research since the industries of developing countries are moving towards sustainable development. Detecting the aforementioned influential factors enables the responsible officials to devise operational plans for industrial parks leading to better effectiveness. Along with the sustainability perspective, several other viewpoints consisting of infrastructural availability, supporting services, training courses, technical consultations, etc. have been considered as the key elements influencing the effectiveness. As another target of this study, the importance degree of each identified factor has been determined since the factors have different importance. Having determined the factors with more importance, the responsible organizations will be able to focus on these elements and try to eliminate shortcomings. With the influential factors at hand, this study aims to propose an indigenous model for Iran by which the impacts of the identified factors on the effectiveness of parks can be estimated. Then, this research targets to apply the proposed model to the provinces of Iran in order to determine their performance in terms of the effectiveness of their industrial parks.

1.5. Structure of the paper

The current study has been arranged as follows: Related studies have been reviewed in Section 2. Section 3 explicates the proposed methodology consisting of the developed qualitative and quantitative approaches. Section 3 also embraces the indigenous model proposed by this research for determining the effect of the identified factors on the demand-driven level of the industrial parks working in Iran. Section 4 has been dedicated to the analyses on the reliability of the research instrument and also the validity of the proposed model of this study. In Section 4, the provinces of Iran that accommodate numerous number of parks have been assessed in terms of their effectiveness. Ultimately, Section 5 summarizes the steps which have been taken to complete this research and delivers some concluding points. Moreover, Section 5 proposes some research guidance for future works.

2. Literature Review

2.1. Reviewing the related studies

Industrial parks have a rich literature and embrace a wide range of studies tackling different aspects of this field. Therefore, this study has tried to: (1) focus on the most related previous researches so that this section maintains its relevancy to the current study, and (2) emphasize on the most recent published works to elicit trends. The next sub-section highlights the research gaps and justifies the existence of this study. Veiga and Magrini (2009) focused on analyzing the establishment of eco-industrial parks in Rio de Janeiro, Brazil. They showed that it is possible to acquire a sustainable industrial system in Rio de Janeiro via development of eco-industrial parks. Hu et al. (2009) utilized the Data Envelopment Analysis (DEA) technique to assess the efficiency of the active industrial parks of Taiwan. Geng and Hengxin (2009) focused on several aspects of the industrial parks established in China including: (1) the criteria which are used to locate parks, (2) land ownership, (3) the strategies used for managing environmental impacts of industrial parks, etc. Geng et al. (2010) proposed an emergy-related methodology which integrates economy and ecological elements. The practicality of the developed framework has been demonstrated by assessing environmental and sustainability performances of an industrial park located in Dalian, China. Jung et al. (2013) devised a methodology based on which the social, economic, and environmental performances of EIPs are assessed. Their developed methodology integrates the Multi-Attribute Global Inference of Quality (MAGIQ) and Discounted Cash Flow (DCF) approaches. They applied this proposed evaluation methodology to the EIPs operating in South Korea. Dong et al. (2013) developed a Life Cycle Assessment (LCA) approach for assessing the carbon footprints of industrial parks. For the EIPs of China, Qu et al. (2015) used the factor analysis to find different perspectives of sustainable development outcome. They identified the environmental practices applied by the managers on the Chinese EIPs. Through hierarchical regression evaluations, the researchers investigated how effective is the environmental consciousness of managers on the relation between the environmental practices and sustainable development outcome. Izadikhah and Farzipoor Saen (2015) modified the DEA method and investigated the application of the developed methodology in evaluating the efficiency of several industrial parks working in Iran. To devise development plans for industrial parks in Portugal, Ramos and Fonseca (2016) employed a Multi-Criteria Decision Making (MCDM) methodology to find a sub-regional cluster of parks. Valenzuela-Venegas et al. (2016) investigated the sustainability measures which can be used to evaluate eco-industrial parks. The researchers detected 249 number of indicators and divided them into environmental, social, and economic measures. To find an appropriate subset of the aforementioned indicators, the researchers proposed four criteria such as: (1) understanding, (2) relevance, (3) partial scheme of sustainability, and (4) pragmatism. To assess the properness of industrial zones, Arabsheibani et al. (2016) amalgamated the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method and Analytic Network Process (ANP). In this research, the assessment is conducted in fuzzy environment. The proposed model developed in this study can also be utilized for estimating the efficiency of current parks. Tiu and Cruz (2017) used the Goal Programming (GP) to optimize total economic costs and environmental impact of eco-industrial parks. Bellantuono et al. (2017) focused on characterizing the organizational models of eco-industrial parks and they investigated how these organizational models can affect the sustainability of EIPs. They applied a cluster analysis technique on twenty eight worldwide eco-industrial parks to cluster them based on the organizational aspect. A multi-stage operational methodology has been proposed by Yang et al. (2018) to estimate the efficiency of several industrial parks in Beijing, China. This methodology embraces three stages: (1) progression of business, (2) facilitation of production, and (3) bonus consideration for economic returns. Ribeiro et al. (2018) developed a framework based on which an industrial park can be turned into an eco-industrial park. The proposed framework aims to achieve three targets: (1) sustainable development, (2) enhancing functionality, and (3) integration of industrial symbiosis. The framework has been applied to a French industrial park in order to transform it into an EIP. Van Beers et al. (2020) analyzed the outcome of applying the international framework for eco-industrial parks to a considerable number of parks in several countries. Lin et al. (2020) proposed a framework based on several MCDM-based approaches to determine the reasons that make industrial parks ineffective and unattractive for investors. Valenzuela-Venegas et al. (2020) developed a multi-objective optimization model for designing the material network of industrial parks, where the resilience and economic considerations have been taken into account in their proposed formulation. The proposed problem has been developed based on two eco-industrial parks in Ulsan, South Korea and Kalundborg, Denmark. O'Dwyer et al. (2020) presented an optimization formulation for recovery and treatment of wastewater in EIPs. Genc et al. (2020) presented a design framework for eco-industrial parks considering waste exchanges between the factories working within EIPs. Considering the viewpoint of life cycle concept, Lyu et al. (2020) modeled the cost of treating wastewater in chemical parks. Hong and Gasparatos (2020) offered a thorough perspective on the challenges facing the development of eco-industrial parks in China through reviewing the related literature and via institutional analysis. They considered sustainability and institutional visions in their perspective. Hu et al. (2021a) developed a performance evaluation metric, namely the Water Stewardship Index (WSI) to assess the performance of industrial parks in terms of water consumption, wastewater outflow, and reutilization of water. Hu et al. (2021b) applied the LCA method to analyze the ecological influence of land utilization change on different life stages of EIPs. Hu et al. (2021c) developed a multi-objective optimization model with the help of a Generalized Reduced Gradient (GRG) methodology that optimizes resource consumption and efficiency of industrial parks, concurrently. Tseng et al. (2021) focused on transition of industrial parks to EIPs and proposed a set of attributes for this transition. The Delphi method has been utilized to validate the criteria influencing the transition of industrial parks to EIPs. They hired the fuzzy set theory to transform the qualitative viewpoints of the practitioners into crisp values. To develop a cause and effect model embracing the aforementioned transition attributes, the researchers used the DEMATEL technique. Park and Kim (2022) studied how the sprawl of industrial parks affects the productivity of land. They considered the location factor in their investigation by the sprawl metric. The researchers developed a regression-based model to identify the key factors influencing the productivity of the land used for industrial parks. The impact of circular supply chain management on economic efficiency of China's eco-industrial parks has been studied by Farooque et al. (2022). The conceptual model of this research has been developed by amalgamating the literature of circular supply chain management, Natural Resource-Based View (NRBV), and contingent NRBV. The developed model has been implemented on the data obtained from more than two hundred Chinese companies. Wei et al. (2022) developed a framework embracing environmental, economic, and energy analyses along with an optimization model for designing carbon emissions neutral parks.

2.2. Necessity of the current research

To show the necessity of the current research according to the research gaps, we summarized the features of the previously published studies in Table 1. Table 1 investigates that: (1) Whether the previous studies considered sustainability-related concerns in development of industrial parks or not, (2) Whether the previous works studied the impacts of sustainability-related factors on the effectiveness of industrial parks, (3) What are the proposed methodologies developed in previous researches, and (4) Whether the previously developed methodologies applied to real case studies or not. Figure 1 tries to offer a statistical perspective on the related literature and elaborates the gaps. By reviewing the related literature, the authors have found out that the current study offers the following main contributions:

1. Most of the researches (79%) (Figure 1a) concentrated on sustainable development for industrial parks. This fact highlights the importance of sustainable development for industries; hence, this study has considered sustainability-related factors along with other influential factors in its proposed model.

2. According to Figure 1 (b), exploring the effectiveness or demand-driven level of industrial parks has only been considered in 11% of the studies. This means that the demand-driven level of parks should receive more attention; since this element significantly influences the attraction of investments. Therefore, the current research has embraced this important element in its model and analyzed the impacts of other factors on the effectiveness of parks.

3. One of the innovative points presented in this study is that the impact of sustainability-related factors has not been sufficiently investigated on the effectiveness of industrial parks. According to Table 1 and Figure 1(c), only 7% of the researches studied how the sustainability-related factors influence the demand-driven level of parks. Therefore, the authors of this study were persuaded to step in this direction and conduct this investigation for the industrial parks of Iran.

4. Figure 1(d) indicates that 93% of studies applied their methodologies to real-world cases. Furthermore, the practicality of the model proposed in this study has been a concern for the authors; therefore, this research has tried to capture real-world condition of Iran's parks in determining the influential factors. In this respect, the viewpoints of the active practitioners with sufficient experience have been acquired to bring the proposed model closer to real-world needs. Hence, the practical aspect of this study which incorporated the real situation of Iran's parks is another innovation offered by this research that has not been tackled sufficiently in the existing literature.

5. The hybrid developed methodology of this research is another innovation presented by this study. This methodology concurrently benefits from the qualitative and quantitative aspects. In the employed qualitative approach, the literature along with focus groups have been utilized. In the quantitative approach, a reliable questionnaire has been designed to collect data and the Structural Equation Modelling (SEM) with the help of Confirmatory Factor Analysis (CFA) has been implemented to assess the impacts of the influential factors on the effectiveness of industrial parks. As a result of the hybrid methodology, an indigenous model has been designed for the industrial parks of Iran by which it can be possible to examine the impacts of the influential factors on the performance of these parks.

Table 1. Features of the previously published studies

Source	Sustainability		Effectiveness (Demand-orientation)		Methodology	Case study		Location
	Yes	No	Yes	No		Yes	No	
Veiga and Magrini (2009)	√			√	Comprehensive field research	√		Brazil
Hu et al. (2009)		√		√	DEA	√		Taiwan
Geng and Hengxin (2009)	√		√		Comprehensive field research	√		China
Geng et al. (2010)	√			√	Emergy-related method	√		China
Jung et al. (2013)	√			√	MAGIQ+DCF	√		South Korea
Dong et al. (2013)	√			√	LCA	√		China
Qu et al. (2015)	√			√	Regression analysis	√		China
Izadikhah and Farzipoor Saen (2015)		√		√	DEA	√		Iran
Ramos and Fonseca (2016)		√		√	MCDM	√		Portugal
Arabsheibani et al. (2016)		√		√	MCDM	√		Iran
Tiu and Cruz (2017)	√			√	GP	√		NA
Bellantuono et al. (2017)	√			√	Cluster analysis	√		Worldwide
Yang et al. (2018)		√		√	Multi-stage operational method	√		China
Ribeiro et al. (2018)	√			√	A hybrid method	√		France
Van Beers et al. (2020)	√			√	Comprehensive field research	√		Worldwide
Lin et al. (2020)		√	√		MCDM	√		Taiwan
Valenzuela-Venegas et al. (2020)	√			√	Multi-objective optimization	√		Denmark, South Korea
O’Dwyer et al. (2020)	√			√	Optimization	√		Hypothetical case
Genc et al. (2020)	√			√	Branch & bound	√		China
Lyu et al. (2020)	√			√	LCA	√		China
Hong and Gasparatos (2020)	√		√		Institutional analysis + literature	√		China
Hu et al. (2021a)	√			√	A hybrid method	√		China
Hu et al. (2021b)	√			√	LCA	√		China
Hu et al. (2021c)	√			√	Multi-objective optimization + GRG	√		China
Tseng et al. (2021)	√			√	Delphi + DEMATEL	√		China
Park and Kim (2022)	√			√	Regression analysis	√		South Korea
Farooque et al. (2022)	√			√	NRBV	√		China
Wei et al. (2022)	√			√	Optimization	√		China
This study	**√**		**√**		**A hybrid method** **(Qualitative: Literature + focus groups)** **(Quantitative: Questionnaire + CFA)**	**√**		**Iran**

3. Methodology Of The Research

This research has aimed to detect the factors that significantly influence the effectiveness of industrial parks; therefore, they can attract financial resources from non-governmental entities that seek to pursue and develop their industries in these parks. Through detecting these factors and their corresponding variables, the path of industrial parks to better effectiveness and prosperity will be clarified. In course of finding the influential factors, it will be determined that how effective are the sustainability-related factors on the effectiveness and demand-driven level of the industrial parks in Iran. The process of detecting the influential factors and variables embraces both qualitative and quantitative methodologies. This study amalgamated both qualitative and quantitative methodologies to make sure that the effectiveness of the industrial parks in Iran is significantly affected by the identified factors. To implement the qualitative methodology, several focus groups and the literature of industrial parks have been utilized. To apply the quantitative methodology, a proper questionnaire in terms of reliability has been designed according to the viewpoints of experts to collect data. Then, the Structural Equation Modelling (SEM) approach has been borrowed to model the relations between the detected factors. The details of these methodologies have been discussed in the following sub-sections. Based on the aforementioned descriptions, it is clear that this study proposes a framework to: (1) determine the influential factors and variables, and (2) analyze the impacts of the detected factors and variables on the effectiveness of industrial parks. Figure 2 briefly shows the steps of this developed framework.

3.1. Employed qualitative methodology

To find the most influential factors, two sources have been utilized, namely the literature of industrial parks and the experts who have considerable experience in evaluating the efficacy and effectiveness of industrial parks. The literature has been used to enrich the scientific aspect of the methodology, while the viewpoints of the experts have been applied to: (1) make an indigenous model for the case study of Iran, and (2) strengthen the practicality of the methodology. Based on aforementioned sources, six influential factors with 24 corresponding observed variables have been detected. Investigating the impact of sustainability on the effectiveness of industrial parks was a prominent question for the researchers of this study. Therefore, the proposed model comprises sustainability-related factors (social, environmental, and economic elements) in addition to other effective factors such as accessibility to infrastructural facilities and existence of supporting services provided by responsible organizations. Necessary information regarding the factors and variables have been summarized in Table 2. This table includes: (1) the list of the identified factors and variables, (2) the abbreviations used to represent factors and variables in the model, and (3) the references based on which the factors and variables have been detected. A fishbone diagram has been drawn in Fig. 3 which illustrates the structure of the identified influential factors and their corresponding observed variables. In Fig. 3, four number of variables (EFF-1 to EFF-4) define the effectiveness of parks that take influence from other influential factors. These effectiveness variables are defined as follows: “EFF-1” variable stands for the ratio of the contracts concluded within an industrial park to the total number of contracts concluded in all industrial parks operating in the host province. “EFF-2” variable represents the feedback of the current investors within an industrial parks to other industry owners to partake in that specific park. “EFF-3” variable stands for the capacity of the industrial parks occupied by artisans in the first year of operation (in percent). “EFF-4” variable represents the tendency of the artisans working in an industrial park to reinvest in the same park.

Table 2

Information on the influential factors and observed variables

Factors	Sources	Observed variables	Sources
Accessibility to infrastructural facilities (I)	(Rives and Heaney, 1995)	Amount of utilized fiber optics (I-1) Access to sources of gas supply (I-2) Access to sources of power supply (I-3) Internet bandwidth capacity (I-4)	(Guild, 2000; Shi et al. 2021; Guo et al. 2021)
Existence of supporting services (S)	(Uusikartano et al. 2021)	Number of available fire stations (S-1) Capacity of hospitals in the region (S-2) Average time span with tax exemption (S-3) Number of training courses for the employees working in industrial parks (S-4) Access to supportive technical consultations (S-5)	(Markom et al. 2011; Lehtoranta et al. 2011; Lin et al. 2020)
Social factors (SO)	(Takala and Pallab, 2000; Veiga and Magrini, 2009; Jung et al. 2013; Qu et al. 2015)	Number of unemployed manpower with college degree in the region (SO-1) Number of families in the region (SO-2) Number of employed manpower with college degree in the region (SO-3) Migration from the region in search of a proper job (SO-4) Migration from the region in search of a better job (SO-5) Number of people studying in vocational schools located in the region (SO-6) Number of manpower stationed in industrial parks (SO-7)	(Liang and Wang, 2020)
Environmental factors (EN)	(Takala and Pallab, 2000; Veiga and Magrini, 2009; Jung et al. 2013; Qu et al. 2015)	Emission of pollution to air (EN-1) Sewage treatment policies (EN-2) Water quality (EN-3)	(Tiu and Cruz, 2017; Gao et al. 2021; O'Dwyer et al. 2020)
Economic factors (E)	(Takala and Pallab, 2000; Veiga and Magrini, 2009; Jung et al. 2013; Qu et al. 2015)	Number of active mines in the province (E-1) Number of international industrial companies working in the industrial park (E-2) Number of industrial companies working in the industrial park (E-3) Average income of the people in the province (E-4) Total value added generated by the industries in the industrial park (E-5)	(Hodgkinson et al. 2001; Tu et al. 2014; Noori et al. 2021; Qiu and Luo, 2021)

3.2. Employed quantitative methodology

3.2.1. Data collection and analysis

To conduct the quantitative methodology, a reliable research instrument was needed to gather the required data on the factors and variables that significantly affect the effectiveness of the industrial parks working in Iran. The research instrument developed in this study is a reliable questionnaire which has been designed according to the outputs of the employed qualitative methodology and based on the outcomes of the focus groups embracing a considerable number of experts who have been working on the subject of industrial parks for many years. The structure of the developed questionnaire has been designed based on the five-point Likert scale (Leutner et al., 2017). In the Likert scale, these five points range from "1" to "5", where the number "1" means that the factor is "Unimportant", whereas the number "5" implies that the questioned factor is "Very important" according to the viewpoint of the responder. Having designed the questionnaire, the responders were asked to declare their opinions on the importance of the factors presented by the qualitative methodology based on the five-point Likert scale in which the points have been labeled as ($Unimportant = 1, Slightlyimportant = 2, Moderatelyimportant = 3, Important = 4, Veryimportant = 5$). The designed questionnaire has been reviewed and scrutinized in focus groups for several times by the experts to ensure about its integrity and quality. Having passed the high standards demanded by the experts, the final version of the questionnaire was sent to a target community comprising 920 number of industry practitioners. The target community has been formed via the purposive sampling method. Although the designed questionnaire was sent to 920 experts of the target community, 866 number of experts answered the questions and sent back the completed questionnaire. Therefore, 94.13% of the target community participated in the employed quantitative methodology. To have a better realization of the target community, Fig. 4 delivers some details on the demographic attributes of this community. The average age of the participants was 41.43 years old. Most of the experts that answered the questionnaire were between 35 and 40 years old. Approximately 25% of the interviewees possessed supervisory and managerial job positions. The viewpoints of the experts with supervisory and managerial job positions are highly important since these positions in industrial parks directly encounter the challenges on the course of leading the industrial parks to better effectiveness. In terms of experience, 84.29% of the responders had up to 20 years of experience. Nearly 15% of the responders had more than 20 years of experience. The majority of the target community (approximately 56%) had bachelor's degree or higher. This implies that the target community was highly educated and this community possessed required expertise to comment on the designed questions.

Figure 5 reports the percentage of the industry practitioners that voted for each of the Likert choices in evaluation of each of the latent factors. In Fig. 5, the abbreviations of the Likert choices have been used to save spaces ($U = unimportant, SI = Slightlyimportant, MI = Moderatelyimportant, IMP = Important, VI = Veryimportant, M = Missing$). According to Fig. 5, for the accessibility to infrastructural facilities, the majority of the responders chosen the "important" and "very important" options. More than 67% of the voters replied that the existence of infrastructural facilities is very important for having more effective industrial parks. The majority of the target community (totally 88.79%) thought that the existence of supporting services heavily influences the effectiveness of parks since they voted for the "important" and "very important" options. Nearly 69% of the population believed that social elements are of high importance for the performance of the industrial parks in Iran. Over 91% of the target community believed that the economic factors influence the success of industrial parks on the path of better effectiveness. The target community believed that the environmental considerations are less influential on the effectiveness of the industrial parks in Iran since the majority of the population selected the “moderately important” and “slightly important” options. Therefore, it can be concluded that the environmental degradation is relatively neglected by the investors when they decide to choose an industrial park in which their businesses will be established. Figure 5 indicates that in most cases the responders tended to choose the “important” and “very important” options. This implies that the employed qualitative technique had been an efficient method and it offered the latent factors that remarkably affect the effectiveness of the industrial parks of Iran. The “Unimportant” option was the least selected option with a percentage below 3% for most of the factors. This fact means that the detected factors have been considerably influential based on the viewpoints of the experts. A small fraction of questions were left unanswered and these missing cases were insignificant.

According to the results reported in Fig. 5, it has become clear that the “important” and “very important” choices have been the most selected options by the target community for the “Economic elements” and “Accessibility to infrastructural facilities”. Figure 6 shows the percentage of the target community that selected the “important” and “very important” choices for each of the latent factors.

3.2.2. Statistical perspective on the importance of factors

The authors wanted to ensure that the identified factors significantly affect the effectiveness of the industrial parks of Iran from the perspective of statistics as well. To do so, the average values of the replies acquired by the target community are statistically tested to make sure that these values are significantly different from the “moderately important” choice. If the average value of the replies corresponding to a factor is significantly different from the “moderately important” choice, it will be deduced that the effectiveness of industrial parks takes a significant impact from that factor. Due to the size of the sample which embraces more than thirty observations, the Central Limit Theorem (CLT) (Antonoyiannakis, 2018) enabled us to utilize one-sample t-tests in order to conduct the required statistical experiments. The significance level of 5% has been selected to perform the statistical experiments. In the null hypothesis (H_0) of these statistical tests, it is assumed that the average value of the replies corresponding to a factor is less than or equal to the “moderately important” choice. This implies that the effectiveness of industrial parks is not significantly affected by that factor. If the P-value of the test is less than 0.05, the aforementioned null hypothesis will be rejected; consequently, it can be concluded that the identified factor significantly influences the effectiveness of industrial parks. In Table 3, the results of these statistical tests have been summarized. Table 3 implies that for five out of six factors, the null hypotheses have been rejected since the P-values of the tests are below 0.05. The statistical tests show that the factor “environmental elements” does not significantly affect the effectiveness of parks. The descriptive statistics reported in the previous sub-section approved this fact as well.

Table 3
Summary of the statistical tests on the detected latent factors

Latent factors	P-value	State of the null hypothesis	Explanation
Accessibility to infrastructural facilities	0.003	H_0 is rejected.	The impact of the factor is significant.
Existence of supporting services	0.037	H_0 is rejected.	The impact of the factor is significant.
Social elements	0.043	H_0 is rejected.	The impact of the factor is significant.
Environmental elements	0.154	H_0 is not rejected.	The impact of the factor is not significant.
Economic elements	0.021	H_0 is rejected.	The impact of the factor is significant.

3.2.3. Proposed model

This section is dedicated to developing an indigenous model for the industrial parks operating in Iran so that their effectiveness can be analyzed. The Structural Equation Modelling (SEM) with the help of the Confirmatory Factor Analysis (CFA) technique has been employed to model the relations between the identified latent factors and observed variables. The CFA is a multivariate statistical technique that lies within the class of SEM methods. It has a remarkable applicability in various fields such as behavioral and social sciences. The CFA tackles measurement models and aims to examine how well the data fit these priori hypothesized models. In these models, it is hypothesized that there are causal relations between the latent factors (underlying variables or unobservable constructs) and their indicators (observed variables) (Anderson and Gerbing, 1988). For this research, Fig. 7 shows the developed confirmatory factor analysis model, where variables are divided into two categories: (1) latent factors (unobserved or underlying variables), and (2) observed variables (indicators). The latent factors are believed to affect the observed variables. In Fig. 7, the latent factors are represented by ellipses, while the observed variables are depicted by rectangles. The visual model depicted in Fig. 7 has been structured based on the factors and variables introduced in Table 2. The observed variables are directly measured by researchers. On the opposite, latent factors (unobserved variables) cannot be directly measured; therefore, the relations and correlations between the observed variables are used to measure the latent factors. In the CFA model, the coefficients are called "Factor loadings" or "Structural coefficients" and they have two types: (1) the first type of coefficients represent the correlations between the latent factors (ellipses) and observed variables (rectangles), (2) the second type of coefficients imply the correlations between the latent factors. The effects of latent factors on their corresponding observed variables are depicted by one-sided arrows. These arrows start from the latent factors and end at the observed variables. Each arrow has a magnitude that linearly relates an observed variable to its corresponding latent factor. Some latent factors and observed variables are not connected via arrows. This means that the latent factor has no theoretical causal impact on the variable. For instance in Fig. 7, there is no arrow linking the factor "SO" to the variable "E-1"; which implies that the latent factor "Social elements" has no causal impact on the observed variable "Number of active mines in the province". In this study, the CFA model has been implemented in the Smart PLS software. The detailed results of factor loadings have been reported in Section 4.3. Since the viewpoints of the experts who are familiar with the situations of Iran have been gathered in determining the influential factors and variables, the developed model is indigenous and it can be fully implemented for local cases.

4. Results And Findings

In this section, the results of implementing the proposed model have been offered. To evaluate the outputs of the developed methodology and model, some performance evaluation metrics were needed. Therefore, Section 4.1 explains the metrics which have been used to assess the research instrument and proposed model in terms of reliability and validity. Then, Sections 4.2 to 4.5 deliver the obtained results and extract discussions from them. Section 4.6 has been assigned to the case study of Iran and the provinces of this country have been evaluated based on the effectiveness of their industrial parks.

4.1. Performance evaluation metrics

This section elaborates some of the well-known performance metrics to evaluate the reliability and validity of the employed research instruments and the developed model. Validity is defined as the accuracy of a survey method in measuring what it intends to measure. A construct embraces a set of related variables. The construct validity is interpreted as a degree to which the conducted measurements literally examine the hypothesis they intend to investigate. In other words, the construct validity determines whether the examination developed to evaluate a construct is literally evaluating that specific construct. Two prominent subsets exist within the construct validity (O'Leary-Kelly and Vokurka, 1998): (1) Convergent construct validity, and (2) Discriminant construct validity. The convergent construct validity indicates that the measures utilized to measure the same construct are related, while the discriminant validity shows the opposite implication and it demonstrates that the measures used for measuring the same construct are not related. There are some metrics in the literature that determine the convergent and discriminant validity which have been used in this section. The employed metrics for evaluating the reliability and validity of the employed research instrument and the developed model include the Cronbach's alpha coefficient (Christmann and Van Aelst, 2006), factor loadings (O'Leary-Kelly and Vokurka, 1998), Average Variance Extracted (AVE) (Hair et al., 2020), Square root of the Average Variance Extracted ($SAVE$) (Gu et al., 2019; Chen et al., 2019), Coefficient of determination (R^2) (Noyan and Simsek, 2012), and Goodness of Fit Index (GFI) (Tenenhaus et al., 2005; Rahman et al., 2013).

4.1.1. Cronbach's alpha coefficient

This famous performance measure is usually employed in the literature of PLS-SEM models to examine whether the research instrument (the designed questionnaire) is reliable or not. Through utilizing this metric, the internal consistency of a research instrument is examined. The correlations between the questions of a research instrument are measured via the Cronbach's alpha coefficient. Higher values of this coefficient convey that the positive correlation between the items of a research instrument is stronger. The coherence of the observed variables pertaining to a latent factor is also demonstrated by the Cronbach's alpha coefficient. This coefficient takes its value from the interval$[0,1]$; however, it should be higher than 0.70 to conclude that the outputs are reliable (Christmann and Van Aelst, 2006).

4.1.2. Factor loadings

Factor loadings represent the correlation between the latent factors and observed variables. To obtain the percentage of the variance in an observed variable which is described by a latent factor, the corresponding factor loading will be squared (O'Leary-Kelly and Vokurka, 1998). This research considers the minimum acceptance value of 0.40 for factor loadings. Thus, the variables with factor loadings less than 0.40 will be eliminated from the model.

4.1.3. Average Variance Extracted (AVE)

This metric is utilized to evaluate the convergent validity and it represents the average amount of variance shared between a construct and its corresponding observed variables. If $(AVE \geq 0.50)$ is acquired for latent factors, convergent validity will be acceptable (Hair et al., 2020).

4.1.4. Square root of the Average Variance Extracted (SAVE)

To assess the discriminant validity, the square root of the average variance extracted ($SAVE$) can be computed. The $SAVE$ value of a factor is compared with the correlation coefficient of that specific factor with other factors. If the $SAVE$ value of this factor is larger than the correlation coefficients of this factor with all other factors, the discriminant validity is confirmed (Gu et al., 2019; Chen et al., 2019).

4.1.5. Coefficient of determination (R^2)

The coefficient of determination (R^2) offers the goodness of fit for the developed measurement models. This coefficient takes its value from the interval $[0,1]$ and it evaluates the relations within a model. In this research, R^2 statistics elaborates the variance within a factor which can be interpreted by other factors. In other words, this metric indicates the amount of change associated with a dependent factor which can be accounted by a single or several independent factors. Suppose that the dependent factor j_1 is under the influence of the independent factors j_2 and j_3. The R^2 statistics has been obtained as 0.75 which means that 75% of the change in the factor j_1 can be interpreted by the factors j_2 and j_3. Higher values of the R^2 metric imply that the independent factors have been more successful in interpreting the changes of the dependent factor (Noyan and Simsek, 2012).

4.1.6. Goodness of Fit Index (GFI)

This index is utilized to measure the fit between the observed covariance matrix and the estimated model. The Goodness of Fit Index (GFI) is obtained as follows (Tenenhaus et al., 2005; Rahman et al., 2013):

$$GFI = \sqrt{\overline{AVE} \times \overline{R^2}} \tag{1}$$

Where, $\overline{AVE}$ and $\overline{R^2}$ are the average values of AVE and R^2, respectively. The GFI takes a value between 0 and 1. The closer the value of GFI to 1, the better the validity and quality of the proposed model. If $(GFI > 0.36)$, it is concluded that the estimated model is properly fitted.

4.2. Reliability of the research instrument

To investigate the reliability of the developed questionnaire, the Cronbach's alpha coefficient has been employed. As stated in Section 4.1, this metric evaluates a questionnaire in terms of its internal consistency. In other words, the correlations between the items of a questionnaire are assessed via this coefficient. The Cronbach's alpha coefficient should be above 0.70 to imply reliable outputs. Figure 8 shows the value of this metric for all identified latent factors of the proposed model. Based on the results in this figure, all obtained Cronbach's alpha coefficients are above the threshold line (0.70). This indicates the appropriate reliability of all identified latent factors. Figure 8 demonstrates that the factor "Social elements" has the highest reliability since it offered the largest Cronbach's alpha value. Although all factors offered sufficient reliability, the factor "Accessibility to infrastructural facilities" has been detected as the least reliable factor in the model since it had the smallest Cronbach's alpha coefficient comparing to other factors. The rectangles in Fig. 8 report the values of coefficients and they also show the ranks of the factors in terms of their reliability. Among the sustainability-related factors, the "Social elements" factor ranked first as well in terms of reliability. The "Environmental elements" was the least reliable factor among the sustainability-related factors. The outputs of the Cronbach's alpha coefficient confirm the significant reliability of the designed questionnaire.

4.3. Results of factor loadings

Table 4 reports the factor loadings obtained by the Smart PLS software for the observed variables of the proposed model. Based on the reports in Table 4, all factor loadings are greater than 0.40 which indicate significant importance of all observed variables. The results shown in Table 4 confirm that according to the acceptance threshold for factor loadings, there was no need to eliminate any observed variable from the developed model. A visual representation of the obtained factor loadings has been presented in Fig. 9 to have an easier comprehension. The factor loading value associated to each observed variable has been shown in Fig. 9 against the threshold line (0.40). In Fig. 9, the observed variable with the highest impact on the corresponding factor has been indicated by an ellipse. From the perspective of “Accessibility to infrastructural facilities”, the observed variable (I-4) (Internet bandwidth capacity) had the highest effect. Regarding the “Existence of supporting services”, Fig. 9 shows that the variable (S-5) (Access to supportive technical consultations) impacted the corresponding factor more than other variables. From the viewpoint of “Social elements”, the variable (SO-2) (Number of families in the region) influenced the associated factor. In terms of “Environmental elements”, the variable (EN-3) (Water quality) was the most important variable. Finally, Fig. 9demonstrates that regarding the “Economic elements”, the variable (E-1) (Number of active mines in the province) had the highest impact on the corresponding factor.

Table 4
Obtained factor loadings of the proposed model

Latent factors	Observed variables	Factor loadings
Accessibility to infrastructural facilities (I)	Amount of utilized fiber optics (I-1)	0.850
	Access to sources of gas supply (I-2)	0.621
	Access to sources of power supply (I-3)	0.444
	Internet bandwidth capacity (I-4)	0.973
Existence of supporting services (S)	Number of available fire stations (S-1)	0.642
	Capacity of hospitals in the region (S-2)	0.429
	Average time span with tax exemption (S-3)	0.442
	Number of training courses for the employees working in industrial parks (S-4)	0.559
	Access to supportive technical consultations (S-5)	0.856
Social elements (SO)	Number of unemployed manpower with college degree in the region (SO-1)	0.906
	Number of families in the region (SO-2)	0.921
	Number of employed manpower with college degree in the region (SO-3)	0.917
	Migration from the region in search of a proper job (SO-4)	0.898
	Migration from the region in search of a better job (SO-5)	0.917
	Number of people studying in vocational schools located in the region (SO-6)	0.568
	Number of manpower stationed in industrial parks (SO-7)	0.446
Environmental elements (EN)	Emission of pollution to air (EN-1)	0.843
	Sewage treatment policies (EN-2)	0.674
	Water quality (EN-3)	0.890
Economic elements (E)	Number of active mines in the province (E-1)	0.767
	Number of international industrial companies working in the industrial park (E-2)	0.556
	Number of industrial companies working in the industrial park (E-3)	0.519
	Average income of the people in the province (E-4)	0.452
	Total value added generated by the industries in the industrial park (E-5)	0.462

4.4. Impact of factors on the effectiveness of industrial parks

Figure 10 demonstrates the impacts of the identified factors on the industrial parks of Iran. According to the results shown in Fig. 10 (acquired by the Smart PLS software), the "Accessibility to infrastructural facilities" was the most influential factor on the effectiveness of industrial parks. On the opposite side, the "Environmental elements" had the least impact on the performance of Iran's parks. From the perspective of sustainability, "Economic elements" had the most impact, while the "Environmental elements" had the least effect on the performance of parks. The "Social elements" ranked the second influential factor in terms of sustainability. The overall ranking of the identified factors is as follows:

$$I > E > S > SO > EN.$$

4.5. Validity of the proposed model

In this section, the validity of the proposed model has been investigated. The acceptability of the proposed model has been appraised by means of different performance metrics mentioned in Section 4.1. These metrics have evaluated the convergent and discriminant validity of the model. One of the metrics which is usually used to validate the models developed in the Smart PLS software is the goodness of fit index (GFI). For this research, the GFI metric is equal to 0.551 against the cut-off value (0.36) which indicates that the proposed model has an appropriate and acceptable model fit. Table 5 embraces the values of AVE for all factors. Based on these outputs, it is obvious that the latent factors have AVE values greater than 0.50; hence, the convergent validity is ensured. In terms of AVE metric, as depicted in Fig. 11, the "Environmental elements" factor has the highest convergent validity among all the identified factors. Therefore, it can be concluded that this factor has the highest convergent validity among sustainability-related factors as well. The least AVE value has been obtained for the "Economic elements". Thus, from the sustainability perspective, this factor has the least convergent validity as well. To test the discriminant validity of the model, the $SAVE$ values have also been reported in Table 5. In Fig. 12, the $SAVE$ values of the factors have been compared with their corresponding threshold values. It should be noted that for acquiring the threshold of each factor, its maximum correlation with other factors has been considered. Suppose that the factor "A" has correlations with two factors "B" and "C". The correlations of the factor "A" with the factors "B" and "C" are equal to "0.73" and "0.68", respectively. Therefore, the threshold value of the factor "A" for assessing its discriminant validity in terms of the $SAVE$ metric is equal to $\max(0.73, 0.68) = 0.73$. As shown in Fig. 12, all factors have $SAVE$ values above their threshold values; thus, the discriminant validity of the developed model has been approved. The coefficient of determination (R^2) obtained for the whole model is equal to 0.521 which shows the moderate impacts of the identified factors on the effectiveness (demand-driven level) of industrial parks. Regarding all performance evaluation metrics, the obtained results have met the required standards; hence, the validity and credibility of the proposed model have been confirmed.

Table 5
Values of the AVE and SAVE metrics

Latent factors	AVE	SAVE
Accessibility to infrastructural facilities (I)	0.603	0.776
Existence of supporting services (S)	0.534	0.730
Social elements (SO)	0.599	0.773
Environmental elements (EN)	0.652	0.807
Economic elements (E)	0.522	0.722

4.6. Analyzing the effectiveness of Iran's industrial parks

In this section, the industrial parks of provinces in Iran have been studied to determine their effectiveness according to the proposed model of this research. Each of these provinces accommodates one or several active parks in which many artisans and private companies use the provided services offered by these parks to produce their products. 172 number of industrial parks around the country have been assessed to compute their effectiveness. By computing the effectiveness of the parks residing in a province, the overall effectiveness of the province will be acquired. Therefore, for each province, an ultimate score is obtained that indicates the overall effectiveness of that region based on the performances of its parks. As mentioned earlier, several variables such as “EFF-1”, “EFF-2”, “EFF-3”, and “EFF-4” have been considered that define the effectiveness of industrial parks. Hence, by means of the values of these variables and the obtained coefficients, the score of each park is acquired. To calculate the overall effectiveness score of each province, the effectiveness values of its parks are averaged. Table 6 delivers the ultimate effectiveness scores of the provinces. The ranking of these provinces has also been mentioned in this table based on the obtained ultimate scores. As reported in Table 6, the “Tehran”, “Khorasan Razavi”, and “Azerbaijan Sharghi” provinces took the first, the second, and the third places based on their ultimate scores. On the other hand, the effectiveness or demand-driven level of the industrial parks residing in the “Kohgiluyeh & Boyer-Ahmad”, “Sistan & Baloochestan”, and “Ilam” provinces was considerably lower than the industrial parks operating in other provinces since they have taken the last three places. The provinces have been sorted in descending order in terms of their performances (ultimate scores). This order has been visually depicted in Fig. 13.

Table 6
Effectiveness scores of the provinces and their ranking

Number	Province	Ultimate score	Ranking
1	Tehran	71.14	1
2	Khorasan Razavi	69.76	2
3	Azerbaijan Sharghi	68.94	3
4	Fars	67.75	4
5	Qom	67.39	5
6	Qazvin	67.06	6
7	Kerman	66.92	7
8	Isfahan	66.73	8
9	Yazd	66.02	9
10	Markazi	65.69	10
11	Khozestan	65.25	11
12	Alborz	64.77	12
13	Zanjan	62.98	13
14	Semnan	62.93	14
15	Gilan	58.89	15
16	Hormozgan	58.83	16
17	Mazandaran	56.36	17
18	Bushehr	55.73	18
19	Khorasan Shomali	54.92	19
20	Kermanshah	54.18	20
21	Golestan	52.01	21
22	Azerbaijan Gharbi	51.89	22
23	Ardabil	51.74	23
24	Hamedan	51.52	24
25	Chaharmahal & Bakhtiari	50.47	25
26	Khorasan Jonoobi	50.09	26
27	Lorestan	44.80	27
28	Kordestan	44.60	28
29	Kohgiluyeh & Boyer-Ahmad	44.60	28
30	Sistan & Baloochestan	41.95	29
31	Ilam	41.93	30

To have a visual representation of the effectiveness scores relating to the studied provinces, Fig. 14 illustrates the map of Iran in which the industrial provinces have been highlighted in blue. The more effective the industrial parks of a province, the darker the color of that specific province. As depicted in Fig. 14 and based on the results reported in Table 6, the “Tehran”, “Khorasan Razavi”, and “Azerbaijan Sharghi” provinces have been highlighted darker than other provinces since they obtained better effectiveness. On the opposite, the “Kohgiluyeh & Boyer-Ahmad”, “Sistan & Baloochestan”, and “Ilam” provinces have been colored lighter according to their low effectiveness scores.

5. Summary And Conclusions

The focus of this study has been on finding the most influential factors and their respective variables that significantly influence the effectiveness of the industrial parks operating in Iran. Reviewing the industrial parks of Iran revealed that more effective parks will be more successful to attract investments from the artisans who seek to establish and develop their businesses in industrial regions with appropriate infrastructure, support, accessibility, etc. Therefore, it was crucial to detect the factors that remarkably enhance the effectiveness or demand-driven level of the industrial parks of Iran. However, the sustainable development of Iran's industrial parks has always been a concern for the country; hence, the process of finding the influential factors had to embrace the sustainability-related factors as well and the impact of the sustainability-related factors on the effectiveness of parks had to be evaluated. In this respect, a hybrid framework comprising qualitative and quantitative methodologies has been developed to detect the aforementioned factors. In the developed qualitative methodology, the authors reviewed the related literature, set up several focus groups, and found some of the most important factors and variables by using the literature and by utilizing the expertise of the practitioners in the focus groups. The proposed qualitative methodology led to detection of six influential factors with 24 corresponding observed variables. Three of these factors, namely "Social elements", "Environmental elements", and "Economic elements" investigate the impact of sustainability on the effectiveness of industrial parks. In the quantitative methodology, a reliable questionnaire was designed which asked the importance of the detected factors from a target community comprising numerous number of experts. Reliability of the questionnaire has been examined through computing the Cronbach's alpha coefficient. The outcomes demonstrated that the Cronbach's alpha coefficients for all detected factors were above 0.70; therefore, it can be inferred that the questions have been strongly consistent with the identified factors. In terms of the Cronbach's alpha coefficient, the questions relating to the factor "Social elements" had the highest reliability among all factors; it means that the "Social elements" has been the most reliable factor among sustainability-related factors as well. Having received and reviewed the replies provided by the target community, it was discovered that most of the identified factors have a significant impact on the effectiveness of Iran's industrial parks. The factors "Economic elements" and "Accessibility to infrastructural facilities" have been the most important detected factors according to the viewpoints of the target community. However, the experts of the community believed that the environmental elements have less impact on the effectiveness of parks. The researchers examined the importance of the discovered factors from the perspective of statistics as well. In this respect, several one-sample t-tests have been conducted that examined whether the average values of the answers received from the community are significantly larger than the "moderately important" option. The outcomes of these statistical tests showed that all identified factors except the "Environmental elements" had significant impacts on the effectiveness of industrial parks. Thus, the results of this phase indicate that the environmental issues and concerns must be taken into account more seriously on the course of sustainable development. Having identified the latent factors and their corresponding variables, a new indigenous PLS-SEM model was implemented in the Smart PLS software that investigated the influence of the detected latent factors and observed variables on the effectiveness of industrial parks. The correlations between the latent factors and their corresponding observed variables have been demonstrated by reporting the values of factor loadings. All obtained factor loadings were above 0.40 which implied the significant importance of all defined observed variables. The identified factors have been sorted based on their influence on the effectiveness of the industrial parks of Iran. Based on the results of the Smart PLS software, the factors "Accessibility to infrastructural facilities", "Economic elements", and "Existence of supporting services" had the highest influence on the effectiveness of Iran's parks. On the other hand, the "Environmental elements" had the least impact on the effectiveness of parks. The validity of the proposed model have been investigated by means of several metrics, namely theGFI, AVE, and $SAVE$. The GFI metric offered by the Smart PLS software was equal to 0.551 against the threshold value of 0.36. Hence, the GFI metric indicated that the proposed model has a remarkable fitness. In terms of the AVE metric, all latent factors had the AVE values higher than 0.50; therefore, the convergent validity of the model has been ensured. It was discovered that the "Environmental elements" had the highest AVE value (convergent validity) among all latent factors. Thus, from the viewpoint of sustainability, the "Environmental elements" had the highest convergent validity as well. The discriminant validity of the proposed model was investigated through the $SAVE$ metric. The outputs showed that all latent factors had $SAVE$ values above their respective thresholds. Hence, the discriminant validity of the model has been ensured. The coefficient of determination (R^2) performance measure offered by the Smart PLS software was equal to 0.521 which showed the moderate influence of the identified factors on the effectiveness of parks. Practicality of this study was a concern of the researchers; therefore, the proposed model was applied to the industrial parks of the provinces of Iran. In this respect, the effectiveness variables have been computed via the outputs provided by the proposed model. 172 number of industrial parks around the country were evaluated and their effectiveness were calculated. Considering the fact that each province could accommodate one or several parks, an overall effectiveness score was computed for each of the provinces. The provinces were ranked according to their overall effectiveness scores. The results indicate that the provinces "Tehran", "Khorasan Razavi", and "Azerbaijan Sharghi" had the highest effectiveness, while the provinces "Kohgiluyeh & Boyer-Ahmad", "Sistan & Baloochestan", and "Ilam" had the least scores. The outputs of the current research can be helpful for the responsible organizations to have a vision on: (1) the effectiveness of the active industrial parks operating in the country, and (2) the attractiveness of the parks for the investors to establish their industries. By means of these results, the responsible organizations can devise proper strategies by which the industrial parks of the country can be led to sustainable development and better performance. Having discovered the most effective provinces, the responsible organizations will know where to locate their future industrial parks so that the investments from the private sector will be maximized. By identifying the least effective provinces, the responsible organizations will know which provinces need more attention and support on the path of sustainable development. For future studies, the authors suggest to embrace uncertainty in the proposed model. Therefore, a framework can be devised that comprises the uncertainty of the collected data. Moreover, the industrial parks and provinces of this study can also be ranked via the multi-criteria decision making approaches and the obtained results can be compared with the outputs of this research.

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Figures

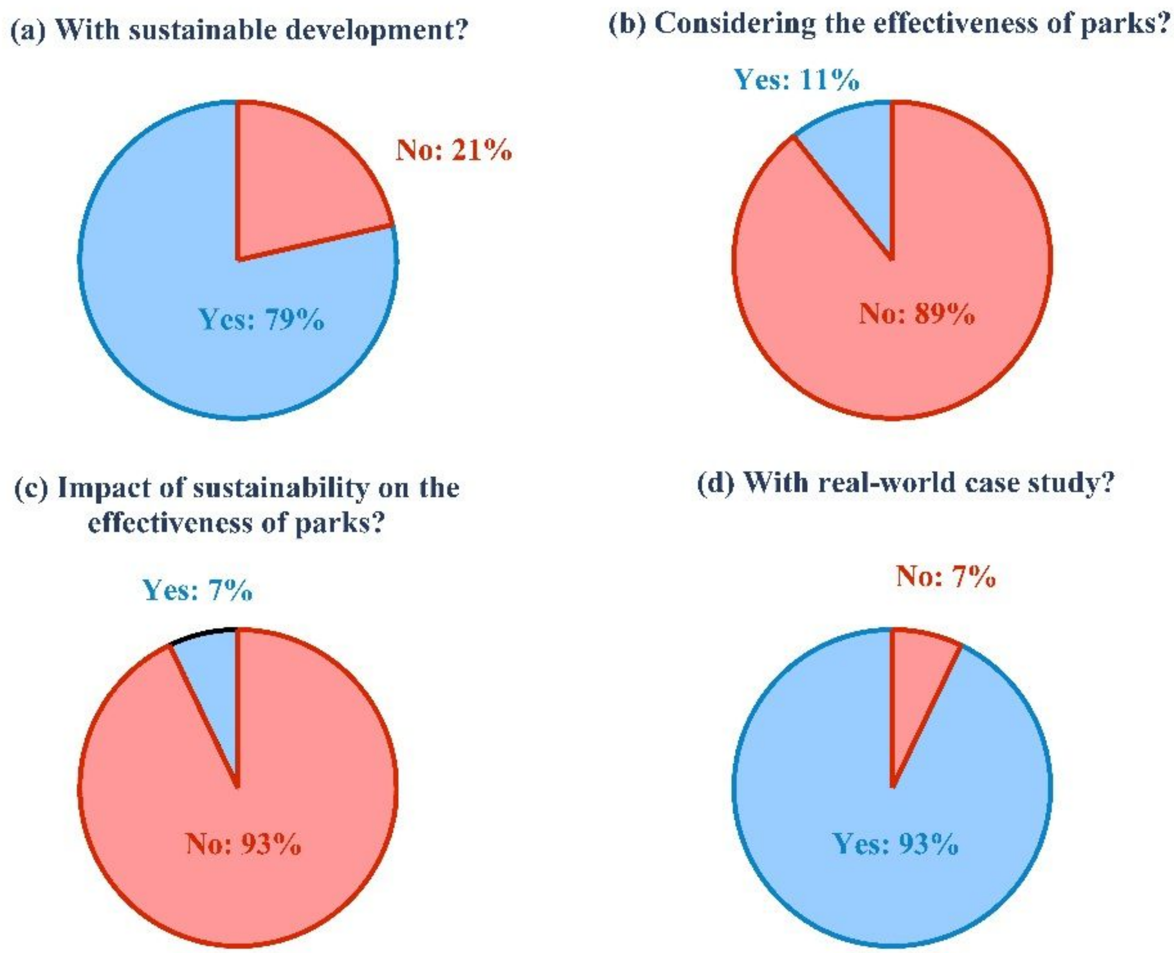

Figure 1

Statistical perspective on the related literature

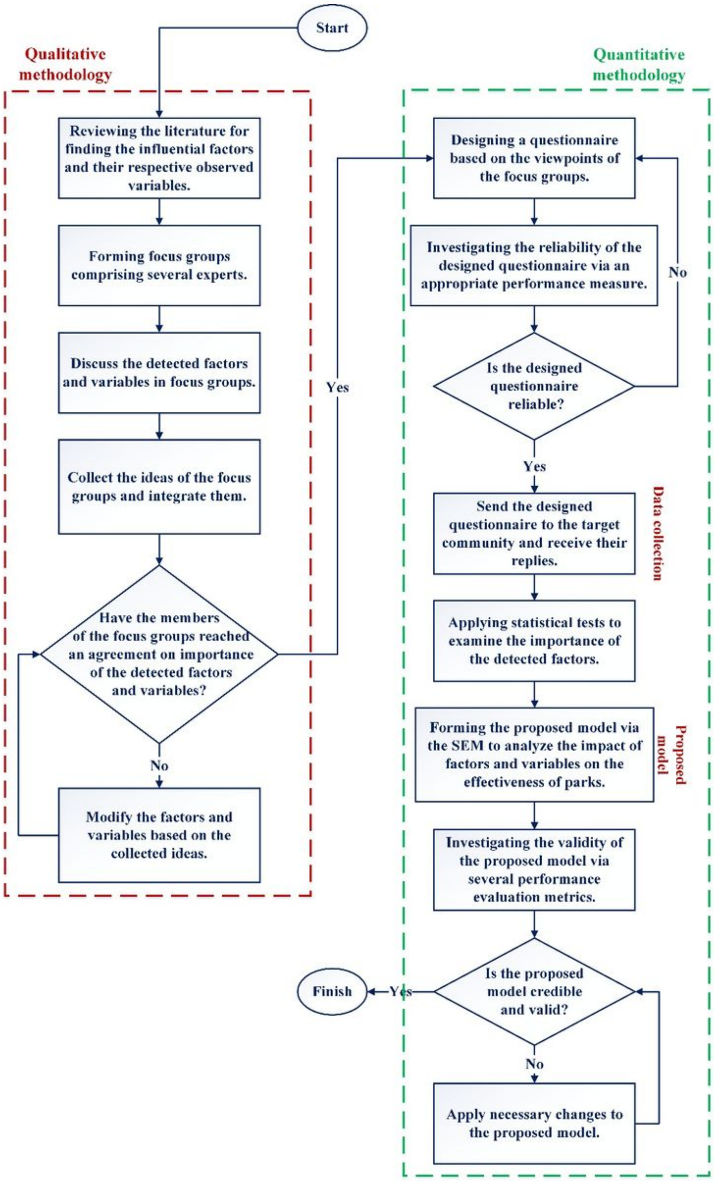

Figure 2

Steps of the developed framework

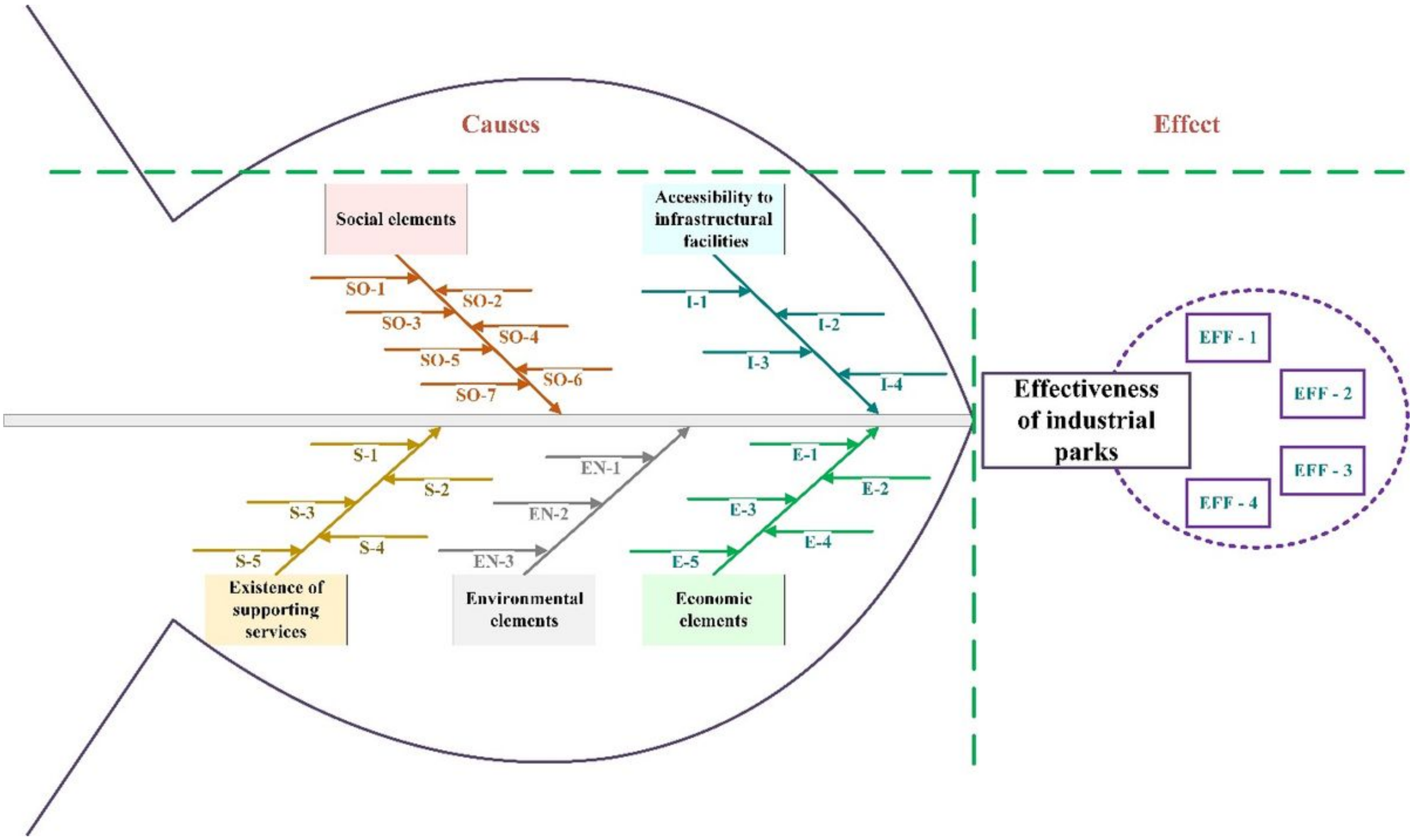

Figure 3

A fishbone diagram introducing the influential factors and their observed variables

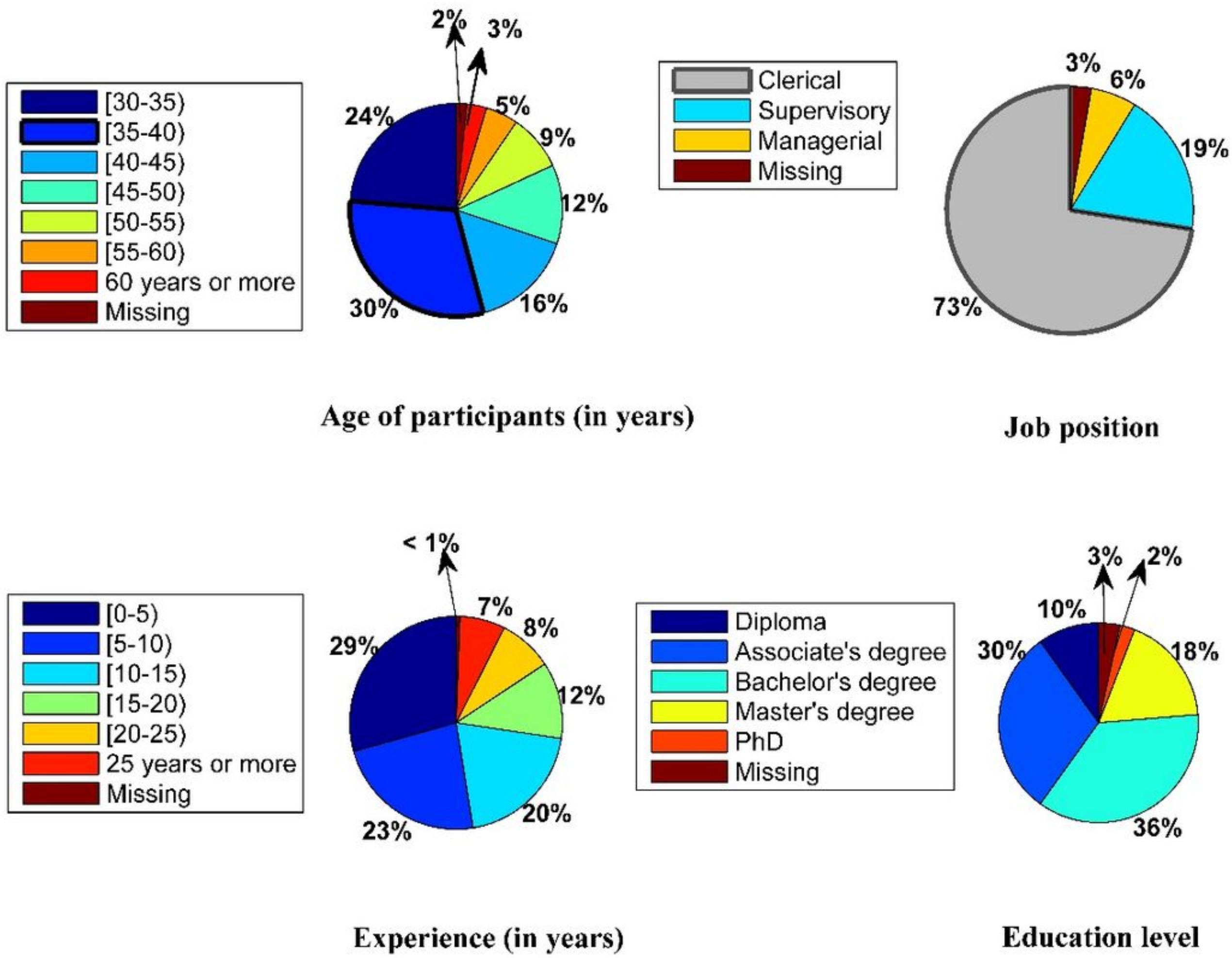

Figure 4

Demographic attributes of the target community

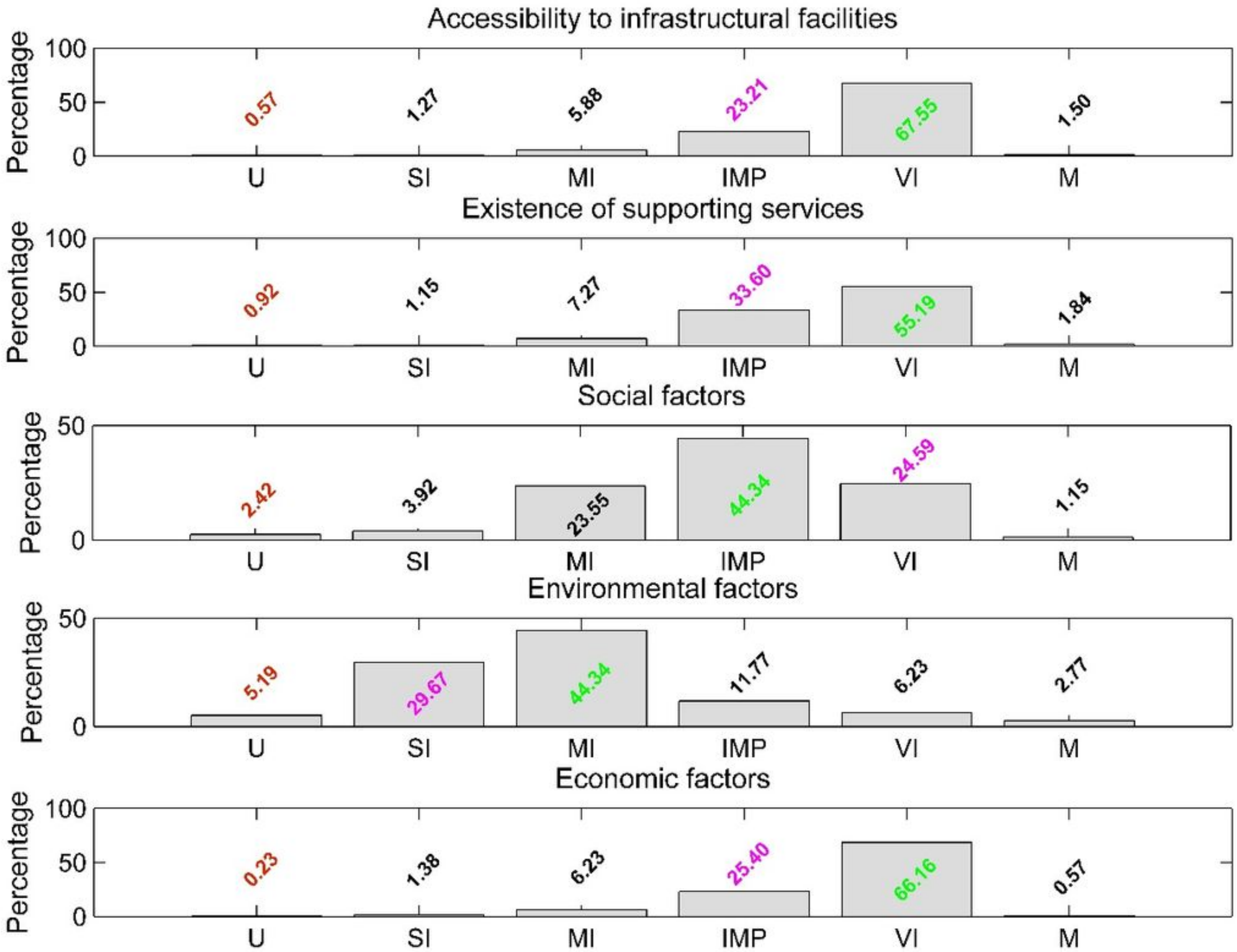

Figure 5

Importance degree of the latent factors declared by the target community

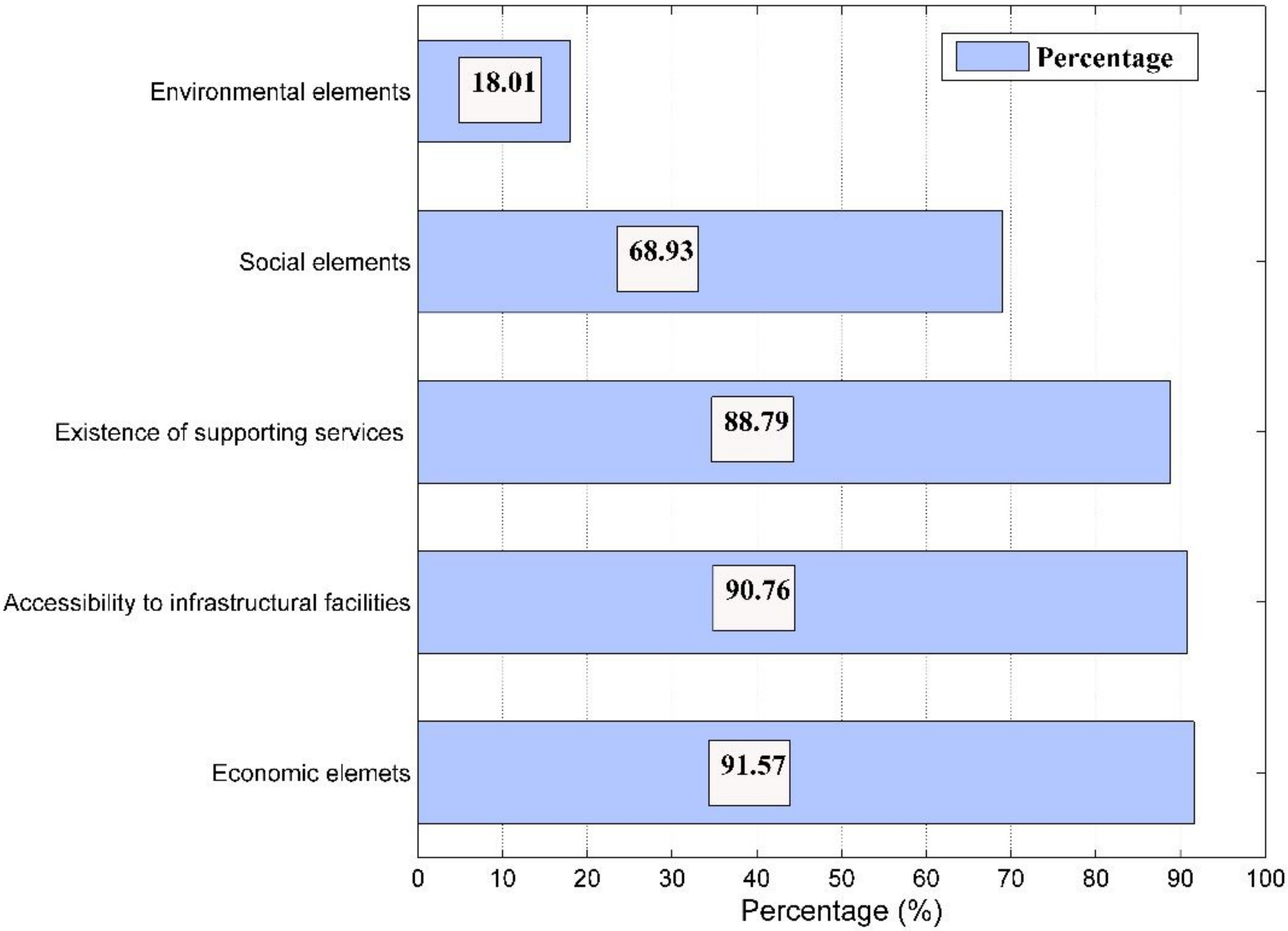

Figure 6

Percentage of the community that selected the important and very important choices for the factors

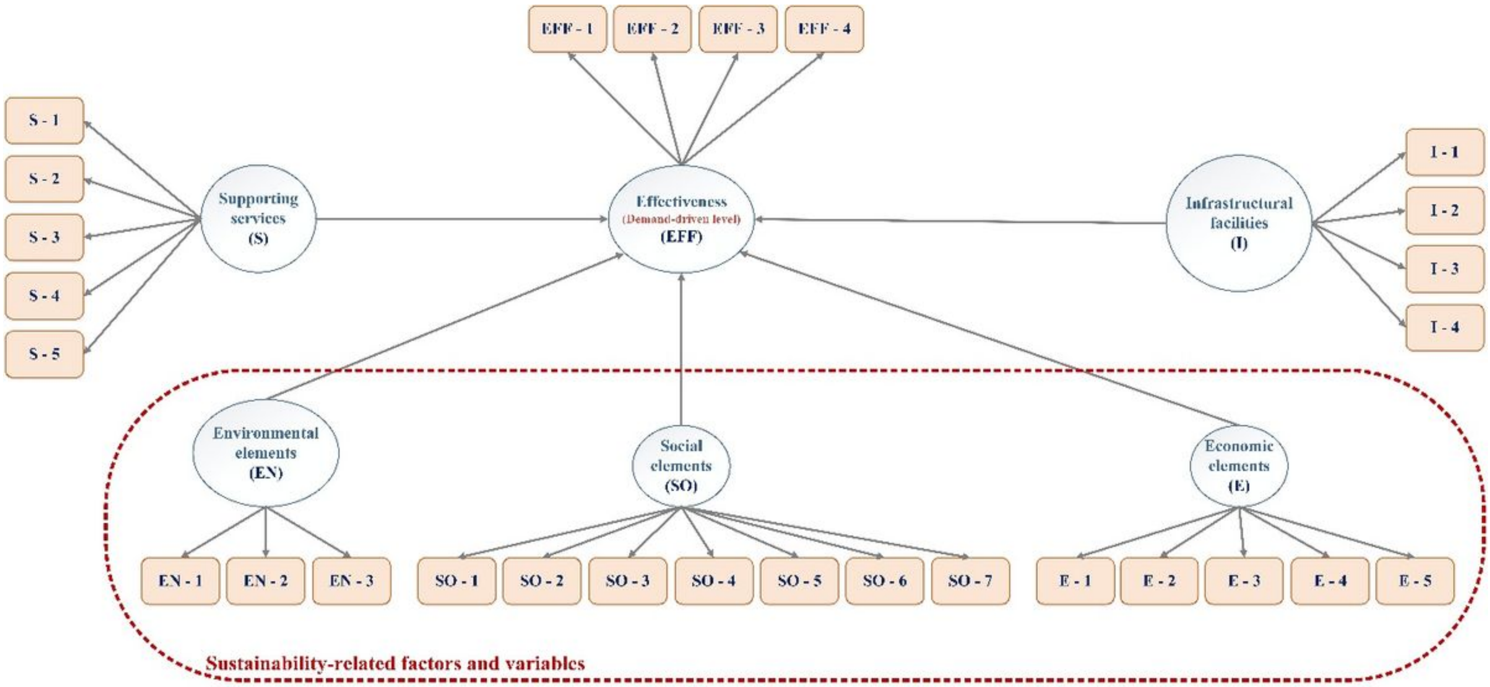

Figure 7

Confirmatory factor analysis model

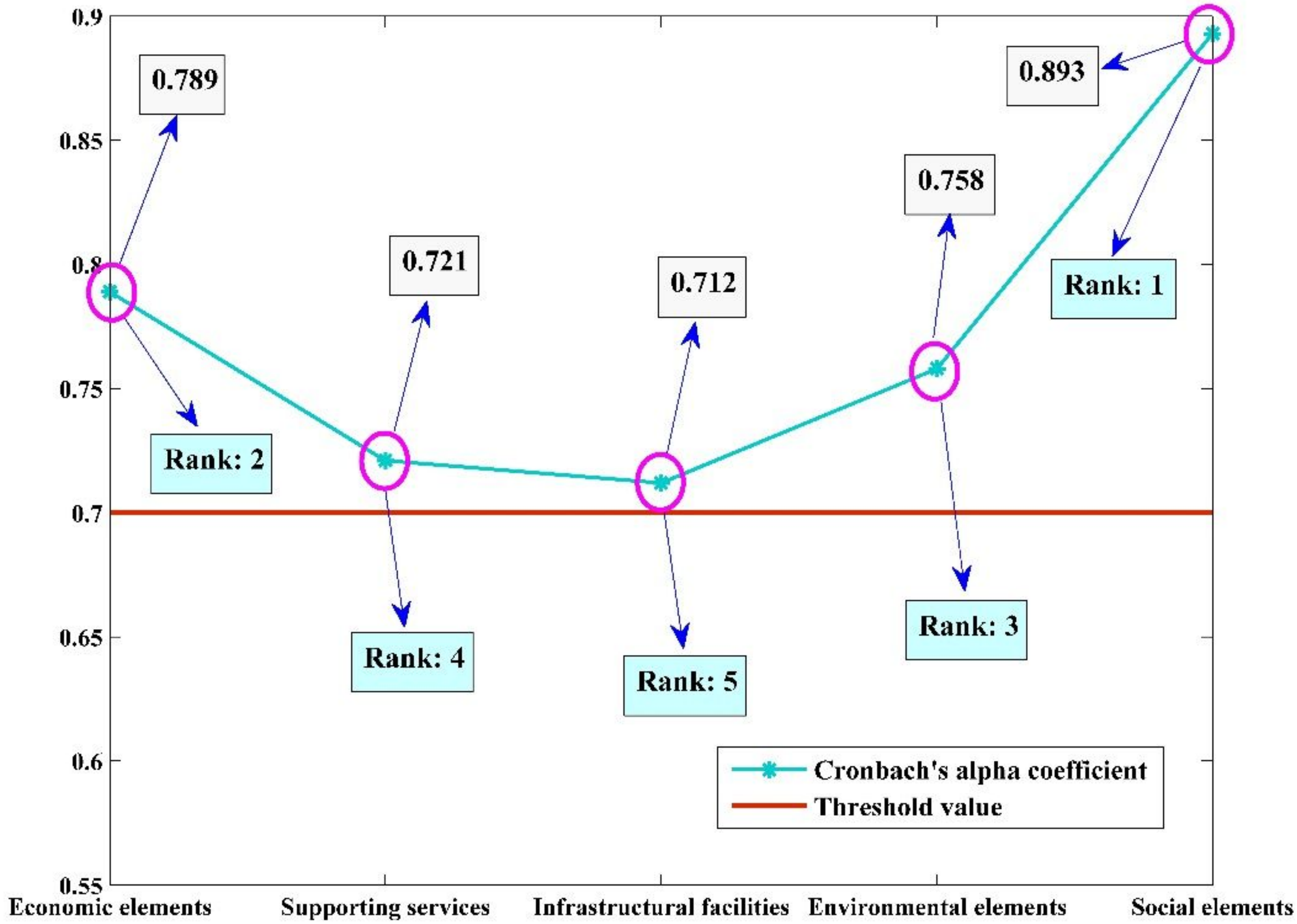

Figure 8

The Cronbach’s alpha coefficients against the threshold line

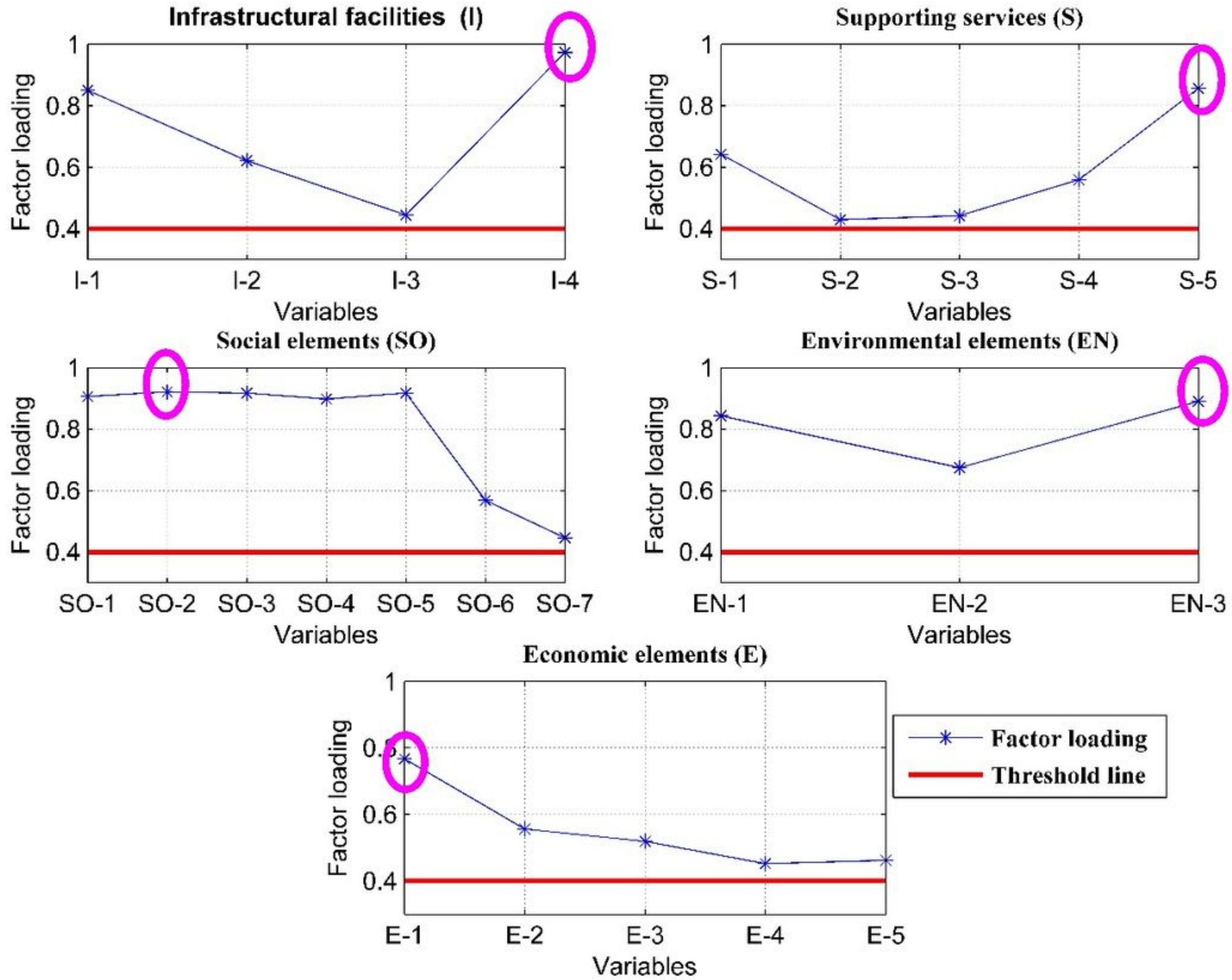

Figure 9

Visual representation of the obtained factor loadings

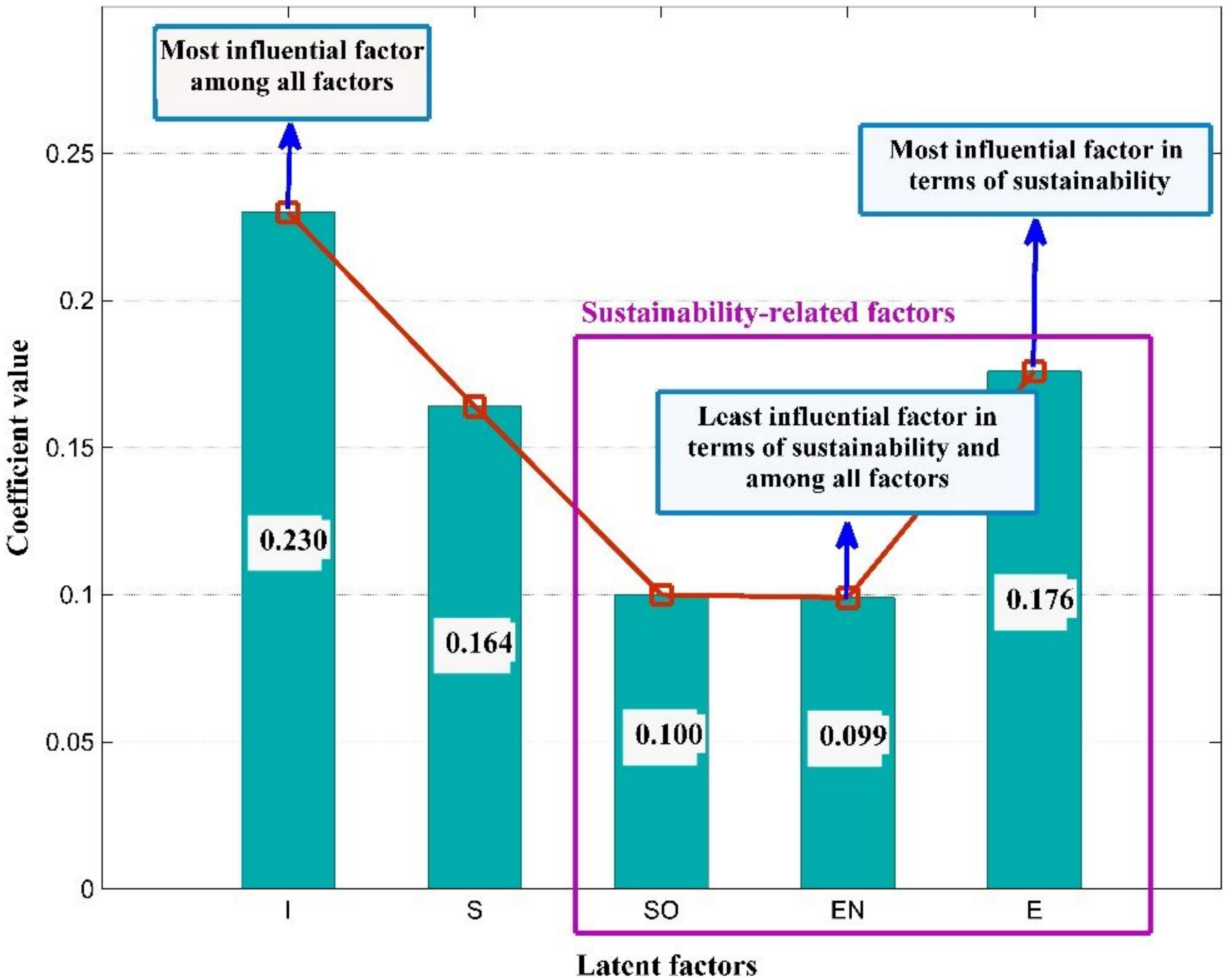

Figure 10

Impacts of the identified factors on the effectiveness of parks

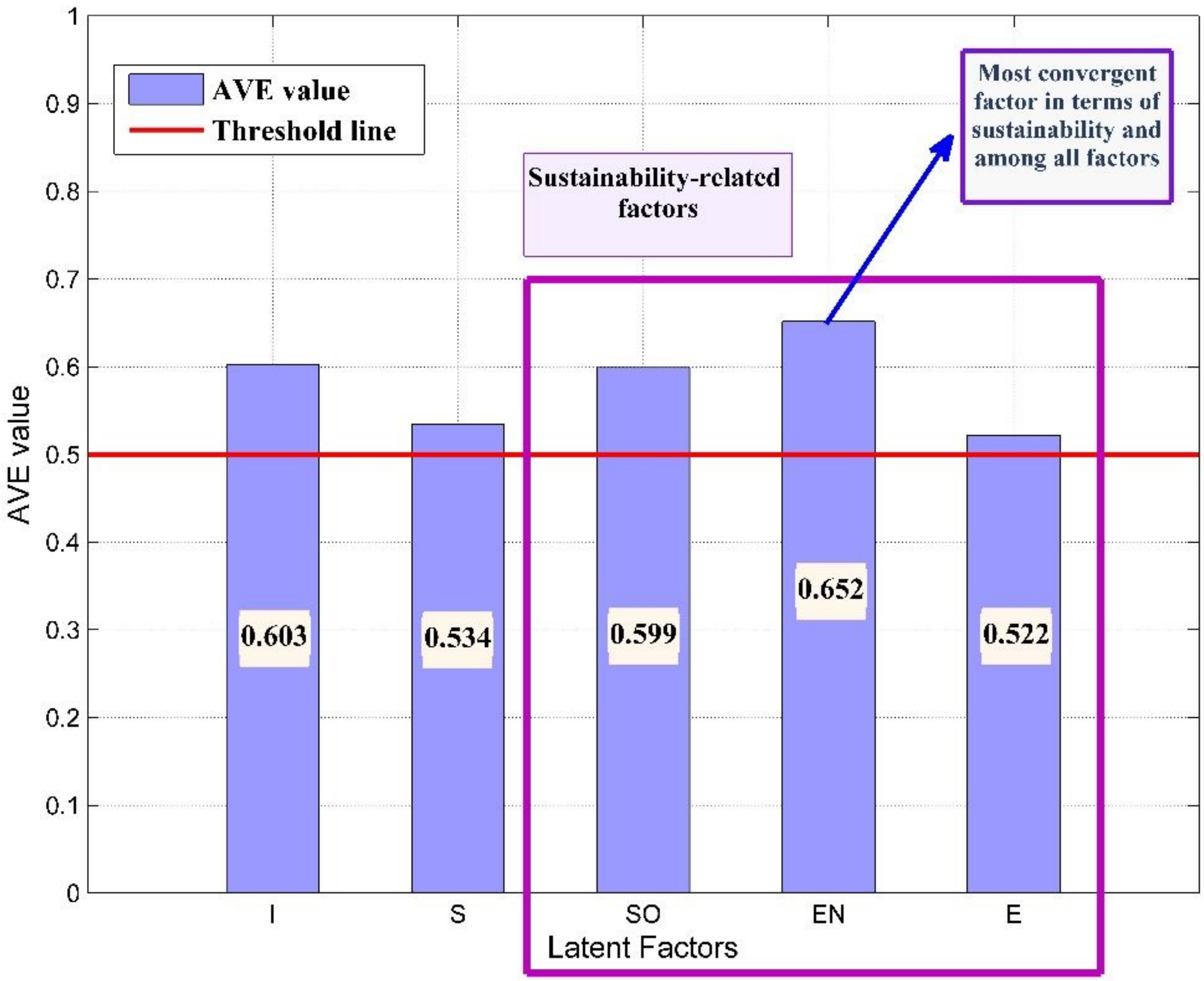

Figure 11

The AVE values of the factors against the threshold line

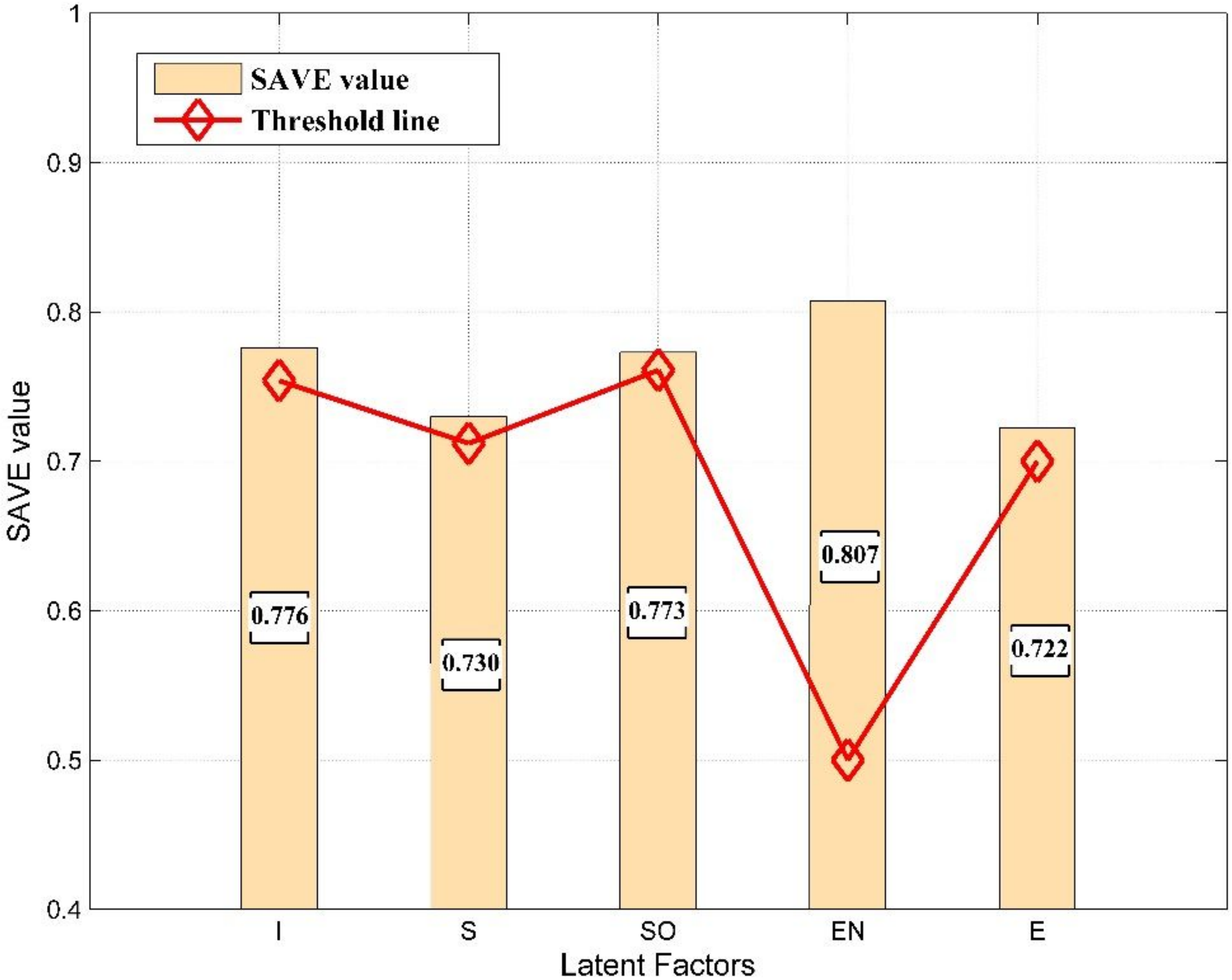

Figure 12

The SAVE values of the factors against the corresponding thresholds

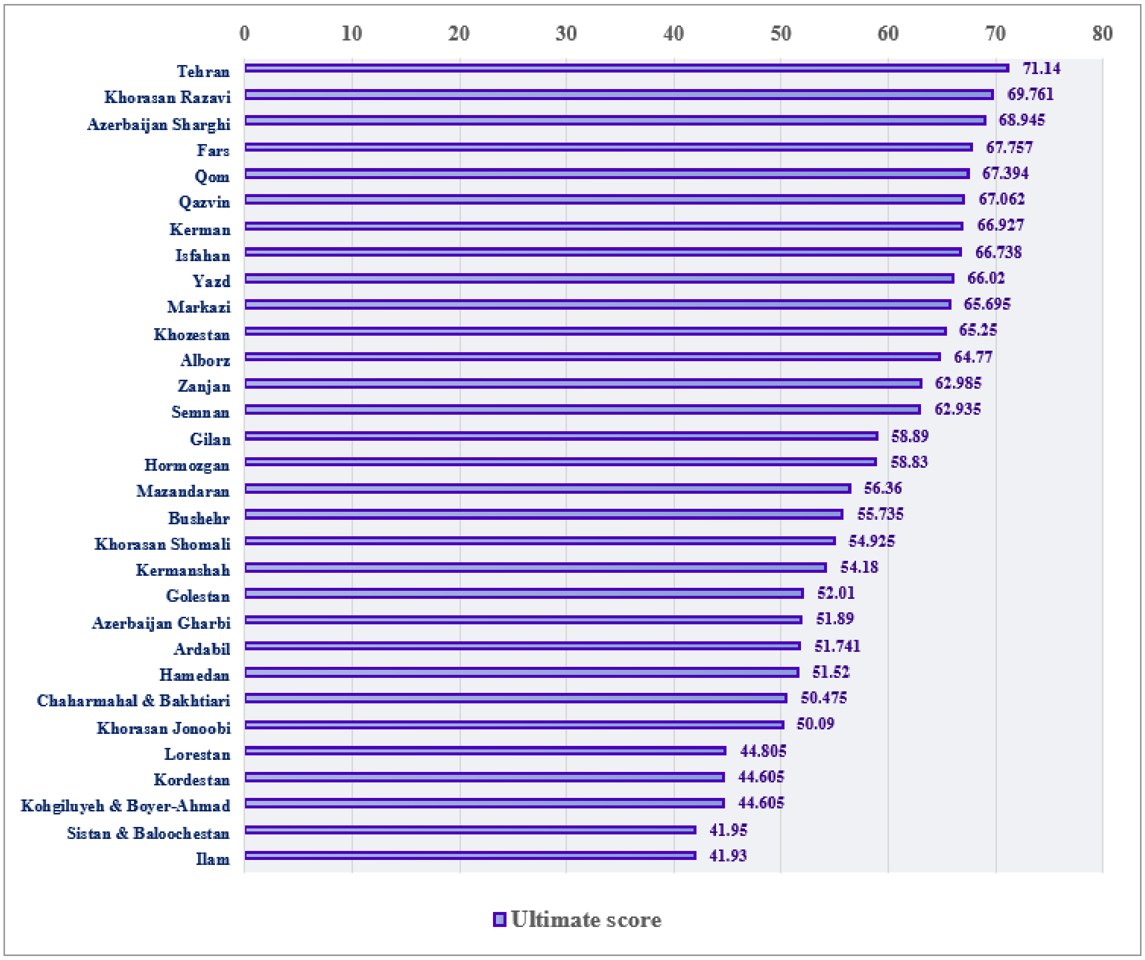

Figure 13

Ultimate scores of the provinces

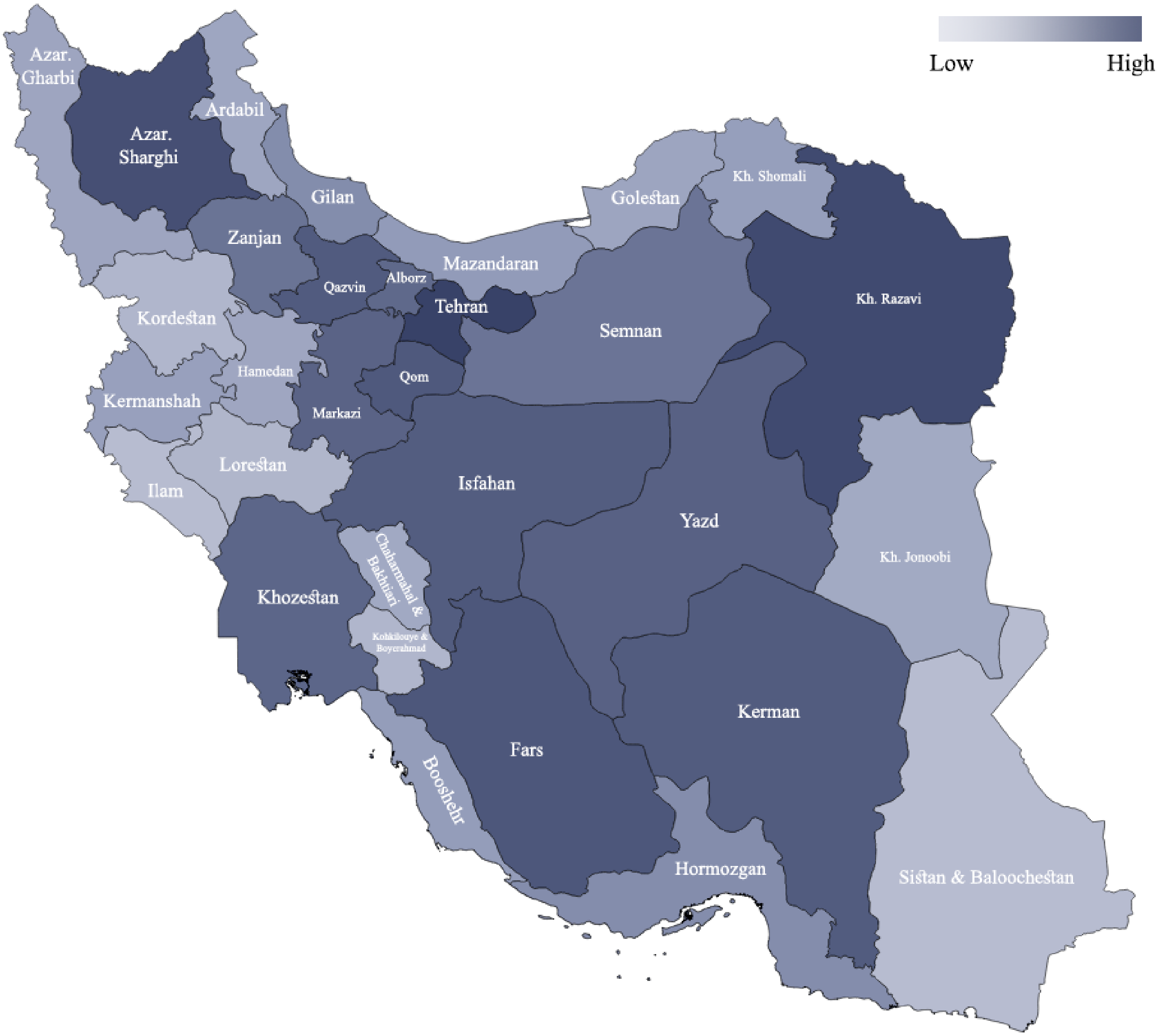

Figure 14

Effectiveness of Iran's industrial provinces