INVESTMENT PRIORITIZING IN HIGH TECH INDUSTRIES BASED ON SWARA-COPRAS APPROACH

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Abstract. One of the symbols of developed countries is high tech industries. High tech industries have a large margin. One of the priorities of developing countries is the progress in this type of industries. The decisions about priority of developing an industry are so hard that seems it should be seen from different perspectives. This research is focused on decision and policy making in priority of high tech industries in Iran. Two MCDM methods are applied in this research for decision making in this area. SWARA for evaluating and weighting criteria and COPRAS for evaluating and ranking alternatives are applied. Eleven experts from different fields participated in this research to make decision with SWARA and COPRAS. Four high tech industries including Biomedical Micro Electromechanical Systems (BioMEMS), Nano Technology, Biotechnology, and Biomedical Engineering were selected for this research. These industries were selected based on the potential of Iran. Final result shows that Nanotechnology is at the top of priorities in Iran. Authors believe that this methodology can be useful in other issues in this and other areas of research.

Keywords: investment, high tech industry, multi criteria decision making (MCDM), SWARA, COPRAS.

JEL Classification: C44, C51, L52.

Introduction

Emerging economies must reinforce their capabilities for investigation so that they can move along with the advanced countries' economies (Tsai *et al.* 2009). In the long time, indeed, economic performance of a country requires to provide, adjust, and link an innovative

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capacity (Ernst 2005; Ernst, Naughton 2005; Tsai *et al.* 2009). In the Islamic Republic of Iran (a developing country) with a population of over 71 million and area of 1,648,195 km^2 in the center of the Middle East, there are over three million university students, of which 65% are women. Almost 35% of the populations are working in the public and private sectors (Ghazinoory, Huisingh 2006; Ghazinoory, Farazkish 2010). Although Iran's economy largely is governed by the government, affiliated companies, or public entities, private sector have a share of 30–40%. There are main active industries in Iran which play significant roles in the export area. Some of them are oil, petrochemicals, steel, food and agriculture industries. The 20% share of industry in Iran's gross domestic product is lower than in most industrialized countries. The rest includes 25% agriculture, 16% oil (average of the past 20 years), as well as the share the service sector. Oil exports provide the 80% of the export income and 50% of the public budget (Ghazinoory 2005; Ghazinoory, Farazkish 2010). As a top priority, improving the scientific and technological developments is the main focus of the Iranian policy-makers in order to accelerate emerging technologies and developing high tech industries in particular (Ghazinoory, Ghazinoori 2006). Policy making in high tech industry is one priority of Iranian policy makers and the government, but investment in industries is enormous for the government. Identifying potential of each work in the country is in the top of priority. Literature of investment is especially important in this area. Social risk, policy risk, economical risk, credit risk, technological risk, interest rate risk and operating risk (Kent 1992; Better *et al.* 2008; Gao *et al.* 2008; Li, Ma 2008; Peng *et al.* 2009, 2010; Shen 2009; Liaudanskienė *et al.* 2010), contract's risks (Zavadskas *et al.* 2010; Boguslauskas *et al.* 2011; Wu *et al.* 2012) are among risks for selecting the kind of investment. The decision making process can be divided into four components from an investor's viewpoint: problem recognition, information search, evaluation of alternatives, and investment decision (Shyng *et al.* 2010; Keršulienė, Turskis 2011). So many research has been done in order to make the optimal investment decision as well as to assess its strategies and risks (Metrick 1999; Bayraktar, Young 2010; Ba *et al.* 2011; Wu *et al.* 2012). This research is focused on priority of investment in high tech industries in Iran. Based on current potential of Iran, four industries were selected at the top of high tech industries including: Biomedical Micro Electromechanical Systems (BioMEMS), Nano Technology, Biotechnology and Biomedical engineering. Prioritizing high tech industries is a Multi Criteria Decision Making (MCDM) issue and is at the top level of decision making process. For this aim, SWARA and COPRAS methods were applied as approaches to solve this problem. SWARA is a new powerful method in MCDM that has an advantage in policy making. COPRAS method is considered for evaluating alternatives of research.

The process of this research is shown in Fig. 1.

1. High tech industries

According to the fifth development plan of Islamic republic of Iran, Iran should move toward a leadership strategy in the Middle East zone. The Fifth development plan illustrated that Iran aims to play the key role in the technology in this zone. Iran has started to develop strategies

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│      Constructing decision making team          │ ⎫
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  ┌───┌─────────────────────────────────────────┐    ⎪
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  │   │    criteria for evaluation process       │   ⎪
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  │   │ Construction of selection criteria and   │   ⎪
  │   │          problem structure               │   ⎪
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┌─────────────────────────────────────────────────┐ ⎫
│       Assigning evaluations via SWARA            │ ⎪
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│         Criteria weights by SWARA                │ ⎭
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┌─────────────────────────────────────────────────┐ ⎫
│         Assigning evaluations                    │ ⎪
│        for COPRAS computations                   │ ⎪
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│          Ranking via COPRAS                      │ ⎪
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│          Select the alternative                  │ ⎭
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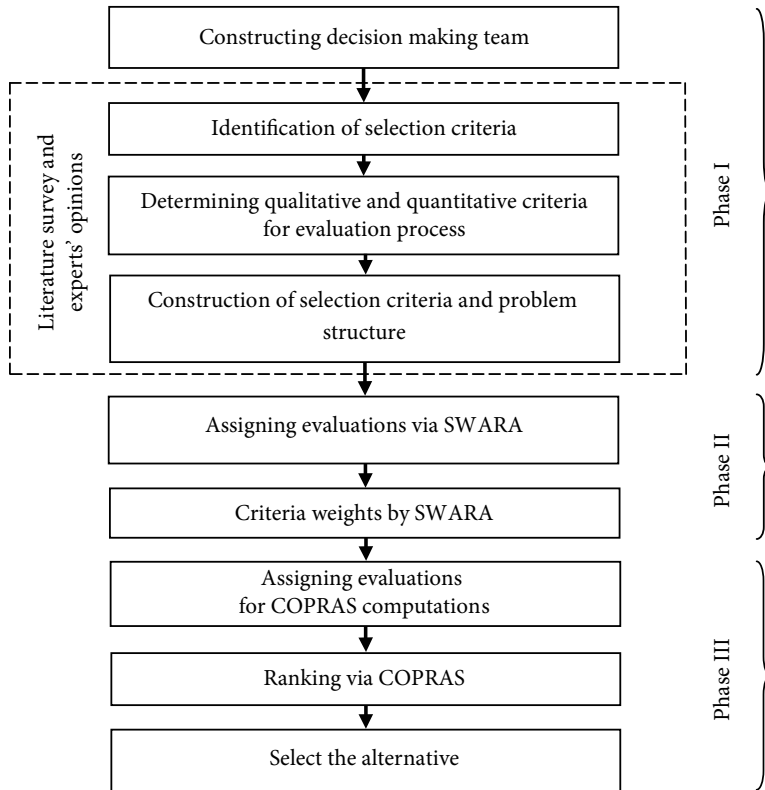*Literature survey and experts' opinions*

Fig. 1. The evaluation procedure of the proposed research

in high tech industries. Four important industries for Iranian government and policy makers are Biomedical Micro Electromechanical Systems, Nano Technology, Biotechnology and Biomedical Engineering. Iran seeks to play an important role in these industries but investment in these industries is so enormous. It's logical to prioritize them based on their preference.

1.1. Biomedical micro electromechanical systems (BioMEMS) (A_1)

From the early 1970s, when micro-electro-mechanical systems were invented by now, the biomedical applications of these miniature systems have been considered so important (Petersen 1982; Wise, Najafi 1991). Today, Biomedical or Biological Micro-Electro-Mechanical Systems (BioMEMS) are the significant subjects of investigation and have a wide range key biomedical application (Ferrari 2004). One can define generally the BioMEMS "devices or systems, constructed using techniques inspired from micro/nano-scale fabrication, that are used for processing, delivery, manipulation, analysis, or construction of biological and chemical entities" which include all interfaces life sciences and biomedical disciplines with micro and nano scale systems (Bashir 2004).

1.2. Nano technology (A_2)

A broad array of techniques for manipulating matter at the scale of nano-sized particles able to change their (normal) physical (mechanical, optical, magnetic, electronic or chemical) properties and behaviour, manifesting new and surprising modes of matter is defined as Nano Technology. Physics, chemistry, material sciences, biotechnology and medicine nanotechnology as the bridging disciplines envision innovative, even revolutionary benefits, creations such as ultra-strong materials, self-cleaning surfaces, high-efficient energy provisioning, and 'intelligent' drugs that can treat patients at cell level (Boholm 2011). Meanwhile, as one of the high technologies, Nano Technology refers to the field of applied science and technology that govern the atomic and molecular scale subjects, generally 100 nanometers or smaller, and the fabrication of devices or materials that lie within that size range (Naschie 2006). Different kinds of the consumer products including cosmetics, cleaning agents, dental care products, electronic components, textiles, paint, coatings, sporting gear, food additives and food packing material, hygiene products, and medicine already were the commercial applications (Boholm 2011). The convergence of the nano technology with other fields, especially biotechnology, information technology, and new technologies is based on cognitive science and results in much of its impact. Thus, the fact is that occurring most of nanotechnology affecting mechanisms through other technologies is natural. Consequently, not all the people in a society will realize the real source of changes (Ghazinoory, Ghazinouri 2009). The question about what differences these will have with other high technologies, such as information technology or biotechnology, has been the main concern in the field of far-ranging claims that have been made about potential applications of nanotechnology (Staggers *et al.* 2008). Nanotechnology, on the one hand, is drawn from some fields such as applied physics, material science, interface and colloidal science, device physics, supra molecular chemistry, self-replicating machines and robotics, chemical engineering, mechanical engineering, biological engineering, and electrical engineering, as a highly multidisciplinary field. On the other hand, other high technologies focus on the limited fields of science and technology (Ghazinoory, Farazkish 2010).

1.3. Biotechnology (A_3)

It is largely considered that Life sciences and biotechnology as one of the most promising advanced technologies for near future are enabling technologies like information technology, applying for many private and public benefits purposes. Regarding the recent scientific developments, the knowledge explosion on living systems brings so many new applications. New and innovative approaches to healthcare are certainly required to respond the ageing populations and poor countries needs. Because either some of disease factors have become resistant to the existing cures like antibiotics, or there is no cure for some diseases at all. However, biotechnology helps the increasing number of medical services and drugs are produced safer, more ethical, and less expensive (e.g. human growth hormone without risk of Creutzfeldt-Jakob disease, treatment for hemophiliacs with unlimited sources of coagulation factors free from AIDS and hepatitis C virus, human insulin, and vaccines against hepatitis B and rabies) (European Commission 2002).

1.4. Biomedical engineering (A_4)

For some reasons, such as lowering the birth rate and aging population in the most countries of the world, 21st century is known as the "human" century. China and India are among those countries with large populations that experience aging during the second half of the century. Thus, the development of medical care, health, and welfare technologies is essential. Both expectations for the creation of new medical technologies stemming from trends in development and practical application of the life, and for the development of medical technologies arising from needs of the global economy are increasing over the time (Kikuchi 2007). The concept of patient monitoring within clinical medicine is a new concept that needs the development of biomedical instrumentation technology to measure the physical and chemical information and signals emitted by the living body in a minimally (or non-) invasive and continuous manner. Therefore, it plays a key role to "enhancement of the quality of medical care". Similarly, the one dimensional measurements of some technology (e.g. medical imaging) have been developed into two- and sometimes three-dimensional measurements and their development is faster than before (Kikuchi 2007).

2. The criteria for selecting high tech industries

There are many factors that can affect policy making for investment in high tech industries. There are not many published research in this area, so more works are necessary. Considering Iran needs, there are some important criteria that we present in this section. The model of research is shown in Table 1.

Table 1. The model of research

Criteria			Reference
Technological factors	Max	C_1	Mäkipelto, Takala 2009; Mäkipelto 2010b; Mendonca 2009; Harbi *et al.* 2009; Athreye, Keeble 2000; Tsai 2004; Praset 1998; Zhang *et al.* 2013
Economic factors	Min	C_2	Mäkipelto, Takala 2009; Mäkipelto 2010b; Chorev, Anderson 2006; Rosa *et al.* 2011
Political and legislative factors	Max	C_3	Mäkipelto, Takala 2009; Mäkipelto 2010b; Liu 1993; Wang 2010; Temouri *et al.* 2010; Hemmert 2004; Godin 2004; Ouyang 2006; Kenney *et al.* 2013; Mamuneas 1999; Lai 2010; Alvarez, Marin 2013
Total costs of investment	Min	C_4	Mäkipelto 2009, 2010a; Bor *et al.* 2010; Hu, Quan 2005; Dulluri, Raghavan 2008; Wu, Chen 2006; Benou, Madura 2005
Social (personnel) factors	Max	C_5	Mäkipelto, Takala 2009; Mäkipelto 2010b; Lin *et al.* 2006; Kulviwat *et al.* 2009; Seo 2013; Baron, Markman 2003; Law, Gunasekaran 2012; Tzafrir, Eitam-Meilik 2005
Suppliers	Max	C_6	Mäkipelto 2009, 2010a; Ruyter *et al.* 2001; Chung *et al.* 2011; Hurmelinna *et al.* 2002; Lee *et al.* 2009a; Lee *et al.* 2009b
Ecological (environmental) factors	Max	C_7	Mäkipelto, Takala 2009; Mäkipelto 2010b; Chu *et al.* 2009; Rosa *et al.* 2011

2.1. Technological factors

The techno-economic features of the investment mode are defined by the technological factors that set some restrictions on the usability. They include the environment-friendly production mode, new high-efficiency technology, production mode that increases flexible production mode.

2.2. Economical factors

The life cycle profits of production investments are affected monetarily by the economical factors such as low operation and maintenance costs, the predictability of the market price, compatibility of the investments with investors' production portfolio, low investment costs, and long-term tax/support policy.

2.3. Political and legislative factors

The investment process with direct or indirect regulation is affected by the political and legislative factors such as the long-term acceptance of investments, equal rights of the different actors, the long-term permission policy, the predictability of the market price, the long-term tax/support policy.

2.4. Total cost of investment

Total cost of investment includes low investment cost, short term of delivery and appraisable operation and management cost.

2.5. Social (personnel) factors

The share of personnel costs of the life cycle profits of the investment is defined by the social (personnel) factors such as the stability of personnel, the flexibility of personnel, the availability of skillful personnel, and low personnel costs.

2.6. Suppliers

Suppliers have key roles in industries. Accessibility, ability in R&D researches, potential in creativity and total cost are important issues in this section.

2.7. Ecological (environmental) factors

The level of environmental friendliness of the investments is described by these factors. The existing needs have to be fulfilled and connected to the environmental needs.

3. Methodology

SWARA method is a new methodology that is suitable in policy making. Decision making at the top level of government is higher than general decision making. SWARA has more concentration on experts' ideas and authors believe that this methodology is the best choice

for applying in this research. COPRAS is also a known method in ranking and prioritizing alternatives. This novel hybrid methodology is considered for this research.

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

Weight assessment is an important issue in many MADM problems. Some famous weight assessment approaches in the literature including analytic hierarchy process (AHP) (Saaty 1980), analytic network process (ANP) (Saaty, Vargas 2001), Entropy (Shannon 1948; Susinskas *et al.* 2011; Keršulienė, Turskis 2011), FARE (Ginevicius 2011), SWARA (Keršulienė *et al.* 2010), etc. Among these methods, SWARA method is one of the brand-new ones.

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

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

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

- Hashemkhani Zolfani and Zavadskas (2013) Sustainable Development of Rural Areas' Building Structures Based on Local Climate;
- Hashemkhani Zolfani *et al.* (2013a) in design of products;
- Hashemkhani Zolfani *et al.* (2013b) in selecting the optimal alternative of mechanical longitudinal ventilation of tunnel pollutants;
- Zolfani *et al.* (2013) Investigating on the success factors of online games based on explorer;
- Hashemkhani *et al.* (2013c) in decision making on business issues with foresight perspective;
- Aghadie *et al.* (2013a) in machine tool selection.

The procedure for the criteria weights determination is presented in Fig. 2.

3.2. COPRAS (Complex Proportional Assessment) method

In order to evaluate the overall efficiency of an alternative, it is essential to identify the most important criteria, to evaluate alternatives and assess information with respect to these
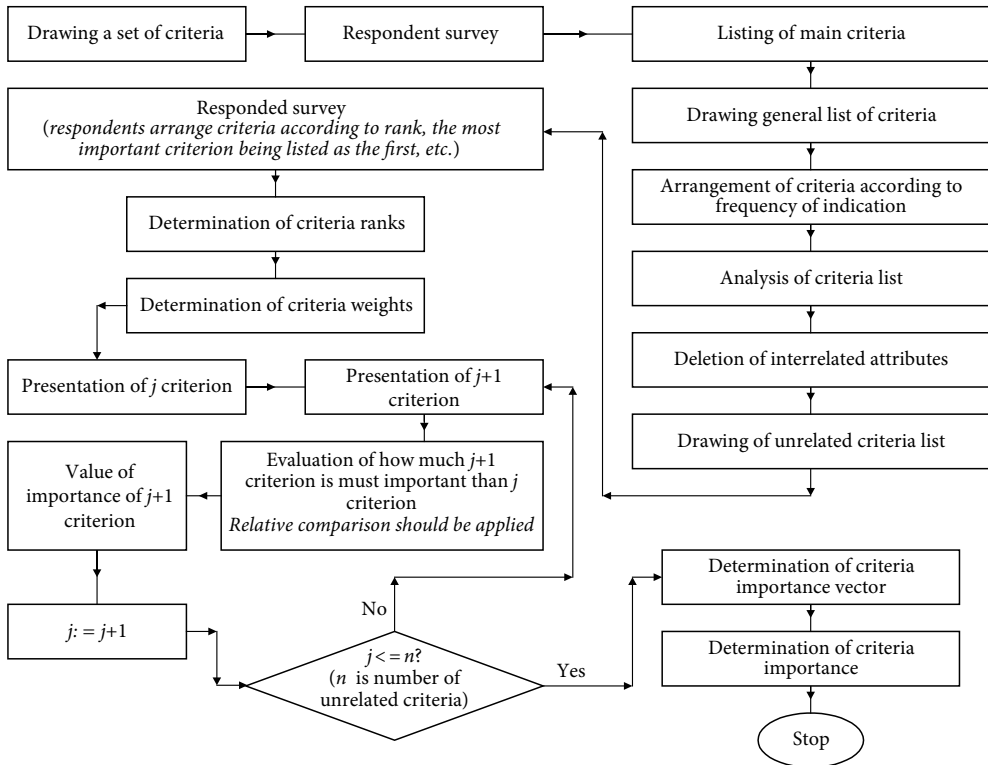
Fig. 2. Determining of the criteria weights based on Keršulienė, Turskis (2011)

criteria; develop methods for evaluating the criteria to meet the DMs' needs. Decision analysis is concerned with the situation in which a DM has to choose among several alternatives by considering a particular set of usually conflicting criteria. For this reason Complex Proportional Assessment (COPRAS) method which was developed by Zavadskas and Kaklauskas (1996) can be applied. In real situations, the most of the criterion for evaluating alternatives deals with vague feature, and values of criteria cannot be expressed with exact numbers.

The recent developments of decision making models based on COPRAS method are listed below:

- Zolfani *et al.* (2011) in forest roads locating;
- Hashemkhani Zolfani *et al.* (2012a) in supplier selection;
- Hashemkhani Zolfani *et al.* (2012b) in quality control manager selection;
- Aghdaie *et al.* (2012) prioritizing projects of municipality;
- Bitarafan *et al.* (2012) evaluating the construction methods of cold-formed steel structures in reconstructing the areas damaged in natural crises;
- Fouladgar *et al.* (2012) maintenance strategy selection;
- Rezaeiniya *et al.* (2012) in greenhouse locating;
- Aghdaie *et al.* (2013b) market segment evaluation and selection.

The procedure of applying the COPRAS method consists in the following steps:
1. Selecting the set of the most important criteria, describing the alternatives;
2. Constructing the decision-making matrix X:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix}; \ i = \overline{1,n} \ \text{and} \ j = \overline{1,m},$$

where: attribute j is in the alternative i of a solution; m is the number of attributes; n is the number of the alternatives compared;

3. Determining significances of the criteria q_i;

4. Normalizing the decision-making matrix $\overline{X}$. The normalized values of this matrix are calculated as:

$$\overline{x}_{ij} = \frac{x_{ij}}{\sum\limits_{j=1}^{n} x_{ij}}; \ i = \overline{1,n} \ \text{and} \ j = \overline{1,m}.$$

After this step we have normalized decision making matrix:

$$\overline{X} = \begin{bmatrix} \overline{x}_{11} & \overline{x}_{12} & \cdots & \overline{x}_{1m} \\ \overline{x}_{12} & \overline{x}_{12} & \cdots & \overline{x}_{2m} \\ \cdots & \cdots & \ddots & \cdots \\ \overline{x}_{n1} & \overline{x}_{n1} & \cdots & \overline{x}_{nm} \end{bmatrix};$$

5. Calculating the weighted normalized decision matrix $\hat{X}$. The weighted normalized values $\hat{X}_{ij}$ are calculated as follows:

$$\hat{x}_{ij} = \overline{x}_{ij} \cdot q_j; i = \overline{1,n} \ \text{and} \ j = \overline{1,m},$$

where: q_i is the significance of the ith criterion. Then, the normalized decision-making matrix is:

$$\hat{X} = \begin{bmatrix} \hat{x}_{11} & \hat{x}_{11} & \cdots & \hat{x}_{11} \\ \hat{x}_{11} & \hat{x}_{11} & \cdots & \hat{x}_{11} \\ \vdots & \vdots & \ddots & \vdots \\ \hat{x}_{11} & \hat{x}_{11} & \cdots & \hat{x}_{11} \end{bmatrix}; \ i = \overline{1,n} \ \text{and} \ j = \overline{1,m}; \tag{5}$$

6. Calculating the sums P_i of criterion values, whose larger values are more preferable:

$$P_i = \sum_{j=1}^{k} \hat{x}_{ij}; \tag{6}$$

7. Calculating the sums R_i of criterion values, whose smaller values are more preferable:

$$R_i = \sum_{j=k+1}^{m} \hat{x}_j. \tag{7}$$

In Eq. (7) $(m-k)$ is the number of criteria which must be minimized.

8. Determining the minimal value of R_i as follows:

$$R_{\min} = \min_i R_i; \ i = \overline{1,n};$$ (8)

9. Calculating the relative significance of each alternatively Q_i the expression:

$$Q_i = P_i + \frac{R_{\min} \sum\limits_{i=1}^{n} R_i}{R_i \sum\limits_{i=1}^{n} \dfrac{R_{\min}}{R_i}};$$ (9)

10. Determining the optimally criterion by K the formula:

$$K = \max_i Q_i; \ i = \overline{1,n};$$ (10)

11. Determining the priority order of the alternatives;

12. Calculating the utility degree of each alternative by the formula:

$$N_i = \frac{Q_i}{Q_{\max}} \times 100\%.$$ (11)

Here Q_i and $Q_{\max}$ are the significances of the alternatives obtained from Eq. (9).

4. Case study

The current study focuses on Iran situation in industries. The case study in Iran can be a suitable case for other research like this. Appropriate choice has a key role in the future of a nation. Developing countries positioned in critical position, policy and decision making in these countries can make a good vision for future but derivative decision can destroy dreams of a nation.

This part consists of three steps. At the first step, information about experts will be presented, because experts are the core of this policy and decision making. At the second step, the results of SWARA method will be presented, and finally at the last step, the results of COPRAS method will be presented.

4.1. Introducing experts

As mentioned in introduction, four industries that are acceptable in Iran, were selected for this comparison and research. In this study, experts were participating in SWARA and COPRAS methods. As we know MCDM methods are based on experts' ideas. The information about experts is shown in Table 2.

4.2. SWARA results

In this section, SWARA is applied for evaluating the model of research that presented in Table 1. Weights and relative importance of each criterion will be calculated in this section. Experts' ideas gathered and its results are shown in Table 3.

Table 2. Background information of experts

Category	Classification	No.
Working background	Engineering	2
	Social sciences	1
	Industries managers	2
	Political sciences	1
	Government managers	3
	Economic	2
Education level	Bachelor	0
	Master	6
	PhD	5
Sex	Male	9
	Female	2

Table 3. Final results of SWARA method in weighting criteria

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \dfrac{x_{j-1}}{k_j}$	Weight $q_j = \dfrac{w_j}{\sum w_j}$
X_2		1	1	0.238
X_3	0.177	1.177	0.849	0.202
X_5	0.223	1.223	0.649	0.154
X_4	0.236	1.236	0.525	0.124
X_1	0.136	1.136	0.462	0.110
X_7	0.191	1.191	0.387	0.092
X_6	0.132	1.132	0.341	0.080
Σ			4.213	

* s_j is calculated based on average of expert's ideas. The information gained privately from each expert and the scale is based multiples of five percent. The impotance of each criterion is calculated based on relative importance of higher criterion. Videlicet, 0.177 shows relative difference of X_3 and X_2. 0.177 is calculated based on experts' ideas and for illustrating s_j all 11 ideas are presented here. Eleven ideas are includes: 0.2, 0.15, 0.3, 0.25, 0.05, 0.2, 0.1, 0.15, 0.2, 0.25, 0.1 and the average of them is 0.177. For other criteria the process are as the same.

Priority, weights and relative importance of each criterion is calculated with SWARA and economical factors are at the top of priority. Results of this step will be used in COPRAS method for evaluating alternatives.

4.3. COPRAS results

After determining all weights of every criterion and sub-criterion by SWARA method, COPRAS method was applied to evaluate and select four alternatives of high tech industries. At this stage of the application, the group of experts evaluated each alternative according to each criterion and Table 4 was developed.

Table 4. Initial decision-making matrix with values of the attributes describing the compared alternatives (COPRAS)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
Opt	Max	Min	Max	Min	Max	Max	Max
Weights	0.238	0.202	0.154	0.124	0.110	0.092	0.080
A_1	6	5	7	4	7	6	6
A_2	7	4	7	4	6	6	7
A_3	6	4	7	3	6	6	7
A_4	5	5	7	4	7	6	6
Σ	24	18	28	15	26	24	26

Besides, Table 4 indicates initial decision making matrix with the criteria values. For the weight q_i of criteria, we used the weights in Table 3. As mentioned before, the aim of using SWARA is to determine important weights of criteria that will be employed in COPRAS method.

Table 5. Weighted normalized matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
Opt	Max	Min	Max	Min	Max	Max	Max
A_1	0.0595	0.0561	0.0385	0.0330	0.0296	0.023	0.0184
A_2	0.0694	0.0448	0.0385	0.0330	0.0253	0.023	0.0215
A_3	0.0595	0.0448	0.0385	0.0248	0.0253	0.023	0.0215
A_4	0.0495	0.0561	0.0385	0.0330	0.0296	0.023	0.0184

The initial decision making matrix, has been normalized first, as discussed in previous section. The weighted normalized decision making matrix is presented in Table 5. According to results of Table 6 which shows evaluation of utility degree: $A_2 > A_3 > A_1 > A_4$.

Table 6. Final results and ranking

P	R	Q	N	Ranking
0.169	0.0891	0.2424	92.55%	3
0.1777	0.0778	0.2619	100%	1
0.1647	0.0696	0.2587	98.77%	2
0.159	0.0891	0.2324	88.73%	4
R_{min}	0.0696			

Due to the last column of Table 6, A_2 is defined as the best alternative in high tech industries investments.

5. Methodological tips

The important point that should be considered in this article, is the application of SWARA method in decision and policy making in top level of decision making and planning. In this

research SWARA method was applied instead of other common methods like AHP and ANP because of general perspective of this method. SWARA framework is totally based on experts and policy makers that make decisions in top levels of organizations, industries and nations. The main idea of this research is at nation perspective and using SWARA method can be reasonable. COPRAS also is a powerful method for evaluating and ranking alternatives in all levels of decision making. COPRAS application is simple and very applicable. This methodology was applied in many research in new century. COPRAS is also known as the one of the best methods in Multi Criteria Decision Making (MCDM) field.

Conclusions

Decision and policy making about national issues is on the top of priority in each country. All programs aim at making a better future, and future can be better than now, if we have appropriate plans for it. All industries are useful and important for nations, but high tech industries are the symbol of developed countries. Developing countries like Iran have plans intended to join developed countries in near future. Iran is a developing country that has a long term planning to join to the developed countries. This research is conducted and structured regarding the fifth development plan of the Islamic Republic of Iran.

Prioritizing industries are very important for the development, and this research focuses on this issue. The process of decision making has a MCDM perspective. Authors believe that MCDM methods can be helpful in this area. Authors proposed two MCDM methods for this research which are SWARA and COPRAS. SWARA is a new and powerful in MCDM that can be useful in policy making issues and is used in this research for prioritizing and weighting criteria.

In this research, eleven experts from different fields participated to solve the problems of SWARA and COPRAS methods. Seven important criteria were selected from literature reviews of this area of research and prioritized after solving SWARA are Economical factors, Political and legislative factors, Social (Personnel) factors, Total costs of investment, Technological factors, Ecological (Environmental) factors and suppliers. In this research, four high tech industries were selected as well, in which Iran has a good potential. Results of COPRAS method show that Nano Technology is the best high tech industry to develop in Iran, after that Biotechnology is at the second place of importance, BioMEMS is the next, and Biomedical engineering is the last priority.

The general scheme of industries is still depending on government in Iran. The result of this research is useful for policies of government, and also private sectors are active in this area. The government should consider playing the important role in this area, therefore, high tech industries can develop with more speed and quality in Iran. It is obvious that this advantage of infrastructures and essential knowledge are present in Iran, and the chance exists that Iran can be one of the best countries in high tech industries in future.

This new hybrid MCDM method can be useful in other similar worldwide research. The authors proposed that this methodology can be helpful in other decision making issues from other areas.

Suggestions of future studies

The authors suggest these matters for future researches as follows:

- Applying this methodology in other places in other countries and comparing the results of the new research with this research;
- Comparing this methodology with other methodologies for investments that presented before in a review article;
- Sensitivity analysis of experts' ideas in SWARA method.

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