



# Country risk assessment by applying multi-criteria decision-making methods: a case study to rank countries in the Middle East & North Africa

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(Received: April 5, 2018 / Accepted: May 4, 2018)

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**Abstract** The Middle East and North Africa (MENA) have been attracting many international investors for decades, but the current geopolitical situation has not shown a welcoming face towards foreign investors. Consequences of war, terror and political changes in the region have forced many international companies to reconsider their future plans in the region or withdraw their investments from the region. On the other hand, there are also companies that have faith in investing in the emerging market of the MENA with fewer competitors in the region. It must be mentioned that narrowing down the best possible decision needs research on the current situation as well as analyzing and forecasting of the upcoming situations in terms of many factors within the country concerned and the region. The Multi-Criteria Decision Making (MCDM) analysis can help investors to choose the best alternative from a set of relevant criteria. In this research, one of the well-known MCDM methods, TOPSIS, was used to rank twenty-three countries based on twenty key indicators collected from the available databanks submitted by the governments within the years 2000-2015. The outcome of these findings provides a set of country rankings for an interested group of decision makers, policy makers, stakeholders, researchers and other involved parties based on their interest in the Middle East and North Africa region in the so-called Arab Spring and post-Arab Spring environment.

**Keywords** Multi-criteria decision making; TOPSIS; Country risk ranking; International investors

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## 1. Introduction

Consequences of war, terror and political changes in the Middle East and North Africa have significantly increased the risk of investments in that region compared to previous decades. Many foreign investors have always seen the Middle East and North Africa as a region with enormous potential and many different resources. Still considering the uncertain instability and risk in MENA that has undergone a lot of changes, mainly affected by the consequences of the so-called Arab Spring in late 2010 and early 2011, international firms are willing to take a calculated risk and invest in the region. For instance, the contract concluded between Iran and the French Energy Giant Total on July 2017, worth nearly \$5bn, aims to develop an offshore gas field in the Persian Gulf. There are many consulting firms that assist such companies throughout their project plan. Such firms analyze different indicators of a particular country that could affect the investor's future in that region.

Bangambiki Habyarimana once stated that "Opportunity and Risk come in pairs" - having this thought in mind, not only opportunity should be considered but also the chances of loss and damage for the company. Which is where Multi-Criteria Decision Making (MCDM) comes in. MCDM has been always an important subfield of operation research and management science over the time. The fundament of MCDM is to determine the best possible solution according to various established criteria and problems, especially relying on inaccurate, uncertain or incomplete information respect to decision makers' preferences where multiple of all the different criteria needed to be considered simultaneously [Abdullah \(2013\)](#). All the methods of MCDM share the same characteristics, the alternatives and criteria must be evaluated as well as the criteria weight that measures the relative importance of each norm. Later on, all alternatives will be compared with one another and the best possible outcome will be chosen accordingly. [Gul et al. \(2016\)](#).

MCDM has two subclasses: These are a) Multi-criteria evaluations problems that have limited alternatives explicitly known at the beginning of the problem-solving process (as seen in this research) and b) Multi-criteria design problems or multi-objective mathematical programming problems where alternatives are infinite, uncountable or not clearly known and must be found by solving mathematical models [Majumder \(2015\)](#).

A decision-making problem can be solved using the following steps [Majumder \(2015\)](#):

1. Knowing the objective of the decision problem
2. Selecting the related alternative
3. Selecting the related criteria
4. Calculating or knowing the weights of each alternative
5. Applying related method/s
6. Making a decision based on the results obtained from the related method

In this paper, twenty-three countries in the Middle East and North Africa has been ranked using the MCDM method, TOPSIS, considering twenty different indicators of twenty-three countries. The data was collected from well-known databanks within a duration of fifteen years (2000-2015) from the International Monetary Fund (IMF), the World Bank and United Nation (UN). The literature related to this approach was derived from the academic databases of Science Direct, IEEE Xplore, Springer and Taylor & Francis and are dated between 2008 and 2017.

## 2. Relevant Research and Literature

Due to globalization the knowledge about a country's performance was of steadily growing importance in the recent years and will play an ever more important role in the future. Each country is trying to improve itself, so it can compete with the other. The result of this study will equip an interested group of decision makers, policy makers, stakeholders, researchers and other parties with a list of scored and ranked countries in the targeted MENA region, which can be found changed in the post-Arab Spring period.

### 2.1. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) by Hwang and Yoon 1982

TOPSIS is a well-recognized MCDM method in ranking problems, such as water resource management, economy and environment and project management. The focus of this method is the distance between the ideal alternatives and non-ideal alternatives that carries the shortest distance to the ideal criteria considered as the best alternative [Radmehr and Araghinejad \(2015\)](#). For instance, TOPSIS was used to locate the best possible region to build solar photovoltaic farms in the southeast of Spain [Sánchez-Lozano et al. \(2016\)](#). The rank was obtained based on the best alternative that carries the closest result to the positive ideal solution among the 10-selected criteria.

TOPSIS can also be used to analyze the business competition. In the research done by [Torlak et al. \(2011\)](#) domestic Turkish airline was compared with each other in order to rank air carries opportunities according to the performance of their 9 key criteria.

TOPSIS was practiced in Energy planning and strategic decision-making problems in the research done by [Ervural et al. \(2017\)](#) whereby a hybrid methodology for Turkey's energy sector strategy was suggested using TOPSIS and SWOT (*Strengths Weaknesses Opportunities Threats*). Another scope of TOPSISI is in the energy consumption sector wherein the research done by [Akbaş and Bilgen \(2017\)](#), different models were studied on energy saving and energy resources efficiently in order to control operations at wastewater treatment plants. With using TOPSIS, a methodology was presented in the research done by [Bilbao-terol et al. \(2014\)](#), which included an evaluation and measurement of the investment sustainability within the sovereign bonds. The study case was applied on three European countries after all counties were considered with regard

to their most frequently used sustainability: the ecological footprint, the environmental performance index, and the adjusted net saving.

The performance of banks has an important effect on developing the economy of a country. Moreover, it becomes an important fact for the investors that are willing to invest in that country. The research done by [Mandic et al. \(2014\)](#) has proposed a mode that assists the investor in having a better understanding to analyze the financial banking system and their performances in Serbian using TOPSIS considering eight the criteria equity, net interest income, liquid assets, cash, portfolio, core business net income, sources and earnings before taxes.

A mode was introduced to assist the maintenance management strategy of a power plant in Turkey by [Can et al. \(2017\)](#). Using this mode, there would be a 77% improvement in the selected equipment maintenance compared to the mode not being used. Another case that TOPSIS was used in is the research done by [Othman et al. \(2015\)](#) where a technique was developed to understand and rank the relationship between psychosocial stresses of the Malaysian seafarers based on the factors affecting their performance that cause injuries and sometimes casualties.

Another utilization of TOPSIS was undergone in the research done by [Yan et al. \(2017\)](#) in waterway congestions when dynamic risk conditions are involved in the Yangtze River in China. Due to congestion problems in waterway transportation, it is necessary to make a flexible decision according to the available risk conditions. TOPSIS was used to choose the best alternative according.

### 3. Methodology

Multi-Criteria Decision Making (MCDM) is one of the well-known sub-discipline offered in operation research where the best decision between two or more criteria can be calculated. Moreover, to select the best suitable decision-making method for different multi-criteria problems, understanding the MCDM classification seems essential. Multi-Objective Decision Making (MODM) and Multi-Attribute Decision Making (MADM) are two classifications of MCDM with both sharing the same characteristics, but different in alternatives structure, where MODM is appropriate for infinite unknown alternative which can be solved using mathematical models. On the other hand, MADM problems are dealing with limited known alternatives represented by their performances in the multiple-criteria problems [Kumar et al. \(2017\)](#). The method used in this paper is MADM method.

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of this method is the distance between the ideal alternatives and non-ideal alternatives that carries the shortest distance to the ideal criteria which consider as the best alternative Radmehr and Araghinejad (2015).

The steps are articulated as following Hwang (2012):

**Step 1:** Forming a performance decision matrix.

In this step the chosen alternatives and criteria were presented in a decision matrix as shown in the following;

Here,  $i = 1.2. \dots m$   $j = 1.2. \dots n$

$$\begin{pmatrix} X_{11} & X_{12} & \dots & X_n \\ X_{21} & X_{22} & \dots & X_{2n} \\ \dots & \dots & \dots & \dots \\ X_{m1} & X_{m2} & \dots & X_{mn} \end{pmatrix} \quad (1)$$

**Step 2:** Normalizing the established matrix by the given formula:

There are a lot of different formulas that can normalize heterogeneous data collected from different resources with different units into a dimensionless unit. Especially in cases where ranking and rating decisions are needed to be calculated.

The following is the formula used in this paper.

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^m (x_{ij})^2}} \quad j = 1. \dots n \quad i = 1. \dots m \quad (2)$$

$$\begin{pmatrix} n_{11} & n_{12} & \dots & \dots & n_n \\ n_{21} & n_{22} & \dots & \dots & n_{2n} \\ \dots & \dots & \dots & \dots & \dots \\ n_{m1} & n_{m2} & \dots & \dots & n_{mn} \end{pmatrix}$$

**Step 3:** The weighted normalized decision matrix is calculated in this step:

$$v_{ij} = w_j * n_{ij} \quad j = 1. \dots n \quad i = 1. \dots m \quad (3)$$

$$\begin{pmatrix} v_{11} & v_{12} & \dots & v_n \\ v_{21} & v_{22} & \dots & v_{2n} \\ \dots & \dots & \dots & \dots \\ v_{m1} & v_{m2} & \dots & v_{mn} \end{pmatrix}$$

**Step 4:** ideal and non-ideal alternatives are determined as follow:

$$A^+ = \{v_1^+ \dots v_n^-\} = (\max_i v_{ij}. j \in J; \min_i v_{ij}. j \in J') \quad i = 1. \dots m \quad (4)$$

$$A^- = \{v_1^- \dots v_n^-\} = (\min_i v_{ij}. j \in J; \max_i v_{ij}. j \in J') \quad i = 1. \dots m \quad (5)$$

**Step 5:** In this step, the Euclidean distances among the ideal and non-ideal alternatives can be calculated respectively as follow:

$$d_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2} \quad (6)$$

$$d_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2} \quad (7)$$

**Step 6:** In this step, the Euclidean distances among the ideal and non-ideal alternatives can be calculated respectively as follow:

$$R_i = \frac{d_i^-}{d_i^+ + d_i^-} \quad (8)$$

**Step 7:** Then the results would be ranked.

### 3.2. Weighting the criteria

Knowing the weight of each criterion in multi-criteria problems play an important role to understand the relative importance of the selected criteria in the multi-criteria analysis methods, depending on the context of the decision making in such problems. Therefore, there are several different methods developed to calculate the criteria priorities into account.

#### 3.2.1 Equal Weight Method

The Equal Weight method (EW) represent a uniform distribution of weight when the decision makers have minimal knowledge about the priorities as shown in the following weight formula [Roszkowska \(2013\)](#):

$$W_j(EW) = \frac{1}{n} \quad j = 1.2. \dots n \quad (9)$$

## 4. Data collection

The data used in this research was collected from the yearly published reports from the governments on their available sectors and indicators in following online databanks: The world bank, international monetary fund, and united nations. But unfortunately, there are some missing data in these databanks therefor, the collected data for this research has been narrowed down to table 1 with twenty-three countries and table 2 twenty indicators in the Middle East and North Africa between the year 2000 to 2015.

Choosing a right set of indicators was a challenging step since some countries have limited resources and limited available data in the databanks. All the indicators were chosen from similar papers and academic literature described in the literature review. In this paper, the judgment of the “the true” weights are vague and cannot exactly be

evaluated with numerical values in practice or if so, it would be probably time-consuming and challenging and it must be consulted by experts. Hence, the Equal weight method was used in this study as shown in table 2.

Table 1. The selected countries in the Middle East and North Africa (alternatives).

Alternatives	Countries
A <sub>1</sub>	Afghanistan
A <sub>2</sub>	Armenia
A <sub>3</sub>	Azerbaijan
A <sub>4</sub>	Bahrain
A <sub>5</sub>	Cyprus
A <sub>6</sub>	Egypt
A <sub>7</sub>	Georgia
A <sub>8</sub>	Iran
A <sub>9</sub>	Iraq
A <sub>10</sub>	Israel
A <sub>11</sub>	Jordan
A <sub>12</sub>	Kazakhstan
A <sub>13</sub>	Kuwait
A <sub>14</sub>	Libya
A <sub>15</sub>	Oman
A <sub>16</sub>	Pakistan
A <sub>17</sub>	Qatar
A <sub>18</sub>	Saudi Arabia
A <sub>19</sub>	Sudan
A <sub>20</sub>	Syrian
A <sub>21</sub>	Tunisia
A <sub>22</sub>	Turkey
A <sub>23</sub>	Yemen

Table 2. The selected indicators (criteria).

Criteria	Indicator	Criteria weight
C <sub>1</sub>	Crop production index (2004-2006 = 100)	0.045454545
C <sub>2</sub>	Current account balance (BoP, current US\$)	0.045454545
C <sub>3</sub>	Deposit interest rate (%)	0.045454545
C <sub>4</sub>	Exports of goods and services (BoP, current US\$)	0.045454545
C <sub>5</sub>	Foreign direct investment, net (BoP, current US\$)	0.045454545
C <sub>6</sub>	GDP (current US\$)	0.045454545
C <sub>7</sub>	General government final consumption expenditure (current US\$)	0.045454545
C <sub>8</sub>	GNI (current US\$)	0.045454545
C <sub>9</sub>	Imports of goods and services (BoP, current US\$)	0.045454545
C <sub>10</sub>	Inflation, GDP deflator (annual %)	0.045454545
C <sub>11</sub>	Labor force, total	0.045454545

Table 2. Continued

Criteria	Indicator	Criteria weight
C <sub>12</sub>	Military expenditure (% of GDP)	0.045454545
C <sub>13</sub>	Natural gas (including LNG) - production "Terajoules"	0.045454545
C <sub>14</sub>	Time required to start a business (days)	0.045454545
C <sub>15</sub>	Total reserves (includes gold, current US\$)	0.045454545
C <sub>16</sub>	Unemployment, total (% of total labor force) (modeled ILO estimate)	0.045454545
C <sub>17</sub>	Fuel oil - Production (Metric tons, thousand)	0.045454545
C <sub>18</sub>	Primary income payments (BoP, current US\$)	0.045454545
C <sub>19</sub>	International tourism, number of arrivals	0.045454545
C <sub>20</sub>	Political Stability and Absence of Violence/Terrorism: Percentile Rank	0.045454545

Table 3. Ranking countries in Middles East and North Africa using TOPSIS.

Rank	Countries	$R_i$
1	Saudi Arabia	0.573489220
2	Turkey	0.468297494
3	Qatar	0.461922290
4	Iran	0.404975548
5	Kuwait	0.389901255
6	Iraq	0.361137754
7	Israel	0.354016829
8	Pakistan	0.351544792
9	Tunisia	0.337496691
10	Egypt	0.325536963
11	Oman	0.317121420
12	Cyprus	0.298411772
13	Bahrain	0.298334515
14	Kazakhstan	0.295727128
15	Azerbaijan	0.279740386
16	Syrian	0.276359586
17	Armenia	0.265852401
18	Georgia	0.265270271
19	Libya	0.264443068
20	Afghanistan	0.260482884
21	Jordan	0.257581303
22	Sudan	0.231908196
23	Yemen	0.226124318



## 5. Results

Table 3 shows the results of the calculation done by TOPSIS method, in this method each country has been given a score and afterward ranked based on their scores. Saudi Arabia, Turkey, Qatar, Iran, and Kuwait are the top 5 countries ranked among twenty-three countries in MENA. Based on these findings a group of internet firms and governments can make decisions about their future investments or partnerships with MENA countries.

It also important to mention that countries that are ranked as lowest and lest desired countries should be as well consider. They might not be a suitable place to invest but those countries need help and supports. All nations are linked to each other and one can affect the other in many ways and since globalization has made it possible to shorten the distances in the world. It is necessary for all countries that help those that are seeking help and support. There are many international Non-Governmental Organizations (NGO) that continuously are helping people around the world.

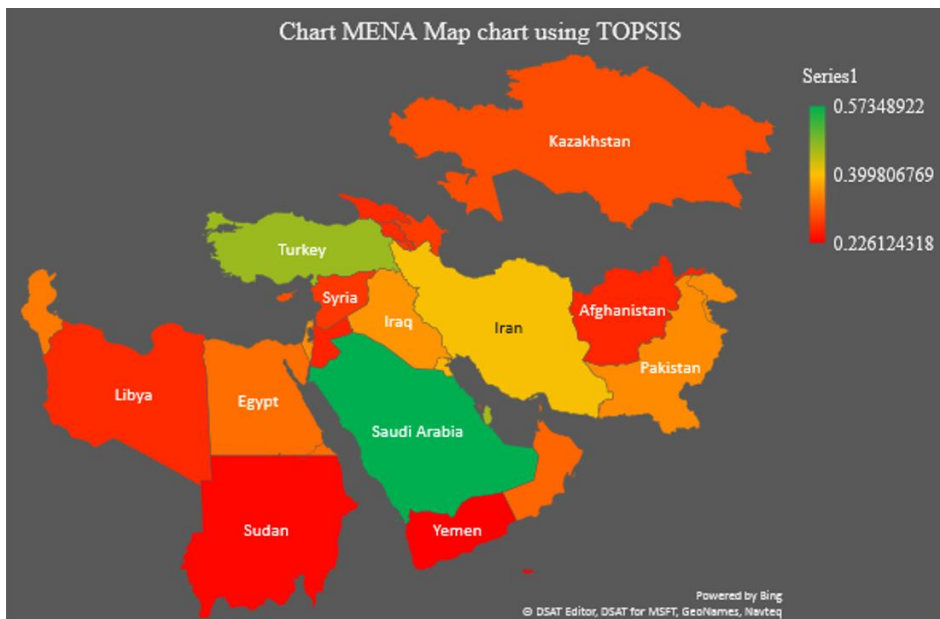


Figure 1. Middle East and North Africa Map chart using TOPSIS.

Based on the results from TOPSIS, figure 1 was created. In this map chart, twenty-three countries of the MENA region were presented in different colors from the highest rank (score 0.57348922) to lowest (score 0.226124318). Those countries which have a better score and higher ranks were colored green and light green, see Saudi Arabia, Turkey, and Qatar.

As the scores and ranking move down, the colors are changing to dark yellow and orange, for instance, Iran, Kuwait, Iraq and at the lowest ranked countries were colored dark red, for instance, Afghanistan, Jordan, Sudan, and Yemen.

From both table 3 and figure 1, it is more likely that Saudi Arabia is targeted by foreign investors since it has been ranked with the highest score as the first country in the MENA region. However, Saudi Arabia is neighboring with Qatar, Iraq, Jordan, and Oman, this is an important fact to considerate neighboring countries in terms of changes in different aspects which can influence Saudi Arabia's foreign policies and stability.

## 6. Conclusion and discussion

The Middle East and North Africa is the region that attracts major international firms and governments for decades due to its rich available resources. This paper has ranked twenty-three countries in the MENA region based on their performances from the year 2000 to 2015. The data was collected from the online databanks, International Monetary Fund (IMF), the World Bank and United Nation (UN). The available data is based on the reports that governments publish every year. The findings of this case study provide a significant MENA country ranking for different parties operating in this region, in particular decision makers, policy makers, stakeholders, and researchers. Multi-Criteria Decision Making was introduced to carry out the calculation. Firstly, the criteria that needed to complete this research were taken from literature and previous papers done on ranking countries. Further on by using Well-know MCDM method TOPSIS twenty-three countries in MENA were ranked based on the performances of twenty indicators within the country.

Saudi Arabia, Turkey, Qatar, Iran, and Kuwait are top five ranked countries in MENA using TOPSIS. In this method, all the criteria were considered to have the same weight to start the calculation with. The reason was that a higher level of experience and expertise in such field was required to estimate indicators' true weights. The next step in TPOSIS was to specify ideal and non-ideal indicators, criteria. Moreover, to rank the countries in MENA the distance between ideal and non-ideal criteria for each alternative was calculated and then the relative closeness of ideal solution for each country was obtained and ranked as it can be seen in table 3.

PROMETHEE is also one of the well-known methods of MCDM that can help in outranking problems such as ranking countries in MENA. In the future studies, PROMETHEE method, as well as a new method or a way to calculate weights for each indicator, will be introduced to have an accurate result for this ranking in the future.

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