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Multicriteria Selection Model of Moroccan Industrial Zones

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Abstract

Whatever the field of activity, locating the production site of a good or a service is a strategic decision that impacts the financial results of the company and sometimes even its future. A favorable location is a competitive advantage for the company and enables it to compete successfully in a highly competitive global market. In order to attract domestic and multinational companies, emerging countries are preparing industrial zones that will facilitate the establishment and economic development. The choice of these zones is generally made taking into account several geographical, urbanistic, demographic and logistical parameters. This paper proposes a multicriteria model of the localization of these industrial zones. It updates the various parameters to be taken into consideration. In particular, the recent and emerging needs for communication infrastructures and new technologies.

Keywords: Industrial zone, localization, selection, multicriteria optimization.

INTRODUCTION

The demographic development associated with the globalization of markets and the increasing uncertainty of the business environment is among the factors that have largely contributed to making the location of industrial activities complex [2].

Undeniably, even if this area has been the subject of a significant number of works both on a fundamental and a practical level, the evolution of business requirements and those of information and communication technologies, the new requirements linked to the reduction of energy consumption and the reduction of the impact on the environment encourage the updating of these traditional models to accommodate these new constraints.

Decisions about a company's location take into account quantitative and qualitative factors that are interdependent and sometimes paradoxical. Indeed, the industry is by nature an anti-urban activity, which is in direct conflict with the well-being of the city. It requires large spaces and communication facilities which is incompatible with traditional urban structures. This has led to an increased complexity of the relationship that governs the economic and social interactions of industrial zones with urban space. The process of evolution and the challenges of urban development have also changed.

On the other hand, the availability of human and material resources, the connection to networks and facilities around the productive sites are essential to the growth and acceleration of material and immaterial flows, and subsequently to the evolution and success of these spaces.

At the macroeconomic level, the establishment of these areas is far from unanimous. Industrial spaces generate spatial disjunctions, remarkable economic and social differences between regions [4].

Equally important is the concern for equity between regions and the desire to combat regional disparities. More often than not, the localization decision is a consensus between the structural relationships between the institution and its environment and is subjectively made on social or political considerations without taking all the factors of success [5].

This article contributes to the understanding of the location of industrial activities and the identification of the characteristics, parameters and elements to be taken into consideration in the decision making of locating industrial zones. The model developed is applied to measure the attractiveness of the industrial zones of the Kingdom of Morocco and adopts ELECTRE 1 as a resolution tool.

LITERATURE REVIEW

The localization was initiated by Weber [6]: a company producing a specific product seeks to optimize the location of these production facilities in the middle of a triangle whose first two peaks are two markets from which it makes its sourcing of materials, and a third market from which the demand comes and on which it sells its products. The aim is to minimize the overall cost according to the cost of transport and the quantities of products to be transported from each of the two upstream markets to the downstream market.

S. HAKIMI (1964) [7] demonstrated that when the network is defined, it is possible to find the solution of the WEBER problem which is necessarily one of the nodes of the network. Knowing that, resolution in the framework of a coherent space gives rise to an infinite number of solutions. In other words, when the network is predefined, the set of possible locations is finite.

The choice of location is generally related to distance and transport costs. The company integrates the notion of distance through transport costs. Therefore, the latter, like other costs, forms part of its maximization program. If the availability of supply and demand does not change according to location (apart from access costs), geographical location will have an influence on the cost function alone (and not on the function of production, M. BECKMANN and JF THISSE (1986) [8]

The localization of several companies in parallel has been studied in the case of a locality, the HAKIMI theorem can be explained as the condition allowing the gathering of companies around several nodes or markets. But multi-gathering is not guaranteed, since nothing prevents that at the equilibrium all the companies will try to locate in the same place. The city center is also a relevant location in many cases. It represents the optimal solution to the WEBER problem.

D. MAILLAT (1998) [9] emphasized the specificity

Movements to stimulate interest in the territories, which results in the gathering of economic players and research and development, training and service activities in an area, which, by their interference, increases skills, abilities, specific skills related to the region. The entourage promotes the dissemination of the training and the good practices which express it by the innovation and consequently the installation of entrepreneurs in the regions.

Mr. STORPER (1995) [10], in his analysis of the contribution of conventions, shows that for companies, the search for maximum profit by defining and positioning their facilities taking into account the importance of market demand and the modalities and costs of production of the area. In this respect, the globalization of enterprises is no longer a threat. It becomes, conversely, a parameter to be integrated into the strategy of managers and executives. Increased annexes and subsidiaries and investment promotion whether international or local must be the willingness of leaders to support their regions via potential investors.

In a model of J. HENDERSON and A. MITRA (1996) [11], the aim is to improve the attractiveness of a developed area and the hypothesis is when there are enough companies zone, this will encourage human resources to come and settle nearby and the city could prosper. So it is the ability to develop the infrastructure of attractive areas in question and prompting policymakers to locate their businesses. The actors cannot take the initiative and decide unilaterally to settle on an area without incentives and without interest.

According to FUJITA et al. (1997) [12] a firm with an important role in the labor market has the ability to anticipate the effects of its choice of location on the overall level of wage costs of its facilities. It is possible to find an interest to settle in a peripheral area and avoid areas where competition is strong and wage costs could be higher. Its location alone is sufficient to make the area attractive.

Companies prefer places of production close to markets where demand is possibly high, where production costs are low and competition is relatively low. Different externalities may, however, influence localization choices. For example, the existence of a labor market for specific skills can lead firms specialized in an activity to group geographically. T. MAYER and J. L. MUCCHIELLI (1999) [13] also show that firms can choose a hierarchical approach to their location (choice of a country, then choice of a region within the selected country).

FUJITA and N. HAMAGUCHI (2001) [14] develop a model on a very similar problem, but on a regional scale. In their model, cities are still mono centric but may be either integrated city equilibrium or specialized (I-specialized equilibrium), and they evolve into a more specialized economy as transport costs decline. They actually study the distribution of two sectors between cities rather than within cities. If they lead to a multi-polar economy with varied degrees of specialization depending on the central location or not of the city studied, they remain within a framework that is more geographical than territorial and even urban.

The rehabilitation of brownfields in urban areas is a major challenge for the sustainable development of cities. However, the management and conversion of these sites, imposed by the regulations, require the development of tools for assessing environmental and health risks and sustainable remediation techniques. Foucault, Y. (2013) [15].

Hlyal. In his two-tier allocation and location model TLCLAP [16] dealt with the specific problem of location of logistics warehouses on the large-scale distribution case and developed a model using a meta-heuristic method based on the genetic algorithm.

Alain, B. (2015) [17], tackled the impact of the land strategy in the creation and development of industrial corridors in Chennai, India (Doctoral dissertation, Paris East). They assume that agglomeration economies are club assets that operate on a metropolitan scale. They test the existence of economies of organizational agglomeration of the kind studied qualitatively by Saxenian (1994) [18]. The results indicate that localization economies are rapidly decreasing and that industrial organization affects the advantages of the agglomeration [19].

Amellal & Bouzidi (2016) [20] treated the case of industrial localization in a region of Morocco using a multi-criteria decision support tool and limited themselves to few criteria.

Even if these research projects involving multiple and exogenous actors [21], [22], [23], [24], [25], [26] 30], [31] [32], few studies attempt to list all the new social, economic, technical and technological elements involved in the selection and location of industrial areas.

Industrial location has undergone unprecedented progress and development in Morocco. Morocco has more than 80 spaces dedicated to industrial activity, spread across the country. These areas are in total more than 4,600 hectares for a total of more than 11,600 lots. These spaces include: integrated industrial parks, zones of economic activity and free zones [33] [34]. In the last decade alone, the Kingdom has attracted several players in the automotive and aeronautical industries. To this end, a major effort has been made by Morocco through the National Plan for the Management of Industrial Areas (PNAZI), implemented since 1980 [35], which has made it possible to cover the entire territory. Several major structuring projects such as ports, motorways and telecommunication reefs have made possible the emergence and success of several industrial zones. In fact, industrial activities, which have developed, have given rise to new needs and organizational needs.

However, some areas have not had the same success and we will try in this article to identify drivers to contribute to the understanding of the location of industrial activities and the identification of key developmental characteristics.

The availability of attractive industrial spaces for investors is a must and currently, 46 industrial zones cover Morocco, 25 of which are equipped and 21 others are under development to meet the needs of domestic and international industrial investors. The selection of the installation area of any industrial project depends on several tangible and intangible criteria, which remain very complex and involve the success or failure of the company.

METHOD

Proposed Method

Faced with this type of decision, the investor can either call on experts who rely on similar cases or use operational research. The main aim of these two approaches is to define the most optimal economic function. However, the considerations are multiple and involve criteria that are not very compatible or even paradoxical, which makes the choice very subjective and irrelevant. To solve this kind of problem, which incorporates quantitative and qualitative criteria, multi-criteria methods are the most appropriate.

In order to measure the attractiveness of the various zones and to measure the impact of each parameter on the score of each zone, we opted for the ELECTRE method.

This method of decision-making multicriteria ELECTRE (Elimination And Choice Translating Reality), known as an upgrade designed by Bernard Roy and based on the stock comparison that was developed by B.Roy [36] following the needs that have arisen in the area of decision support, and to guide a decision-maker in choosing the most appropriate option among several alternatives in the light of the completed interpretations of the evaluations carried out.

It will be used to synthesize the information contained in each criterion and to judge the relevance of the choice of industrial zones. This interpretation of the criterion evaluations for each considered alternative follows a procedure for describing the advantages and disadvantages of alternative areas in a logical framework in order to assess their real benefits; which is the aim of ELECTRE methods developed by B. Roy [36].

Phase 1: Judgments

• Determine coherent criteria

• Assign weights to the various criteria considered,

• Evaluate each action against each criterion and develop the matrix.

Phase 2: the indices

• For each ordered pair of actions, assume that the first action outperforms the second and confront this assumption with the numbers in the matrix

• Add the weights of the criteria that are consistent with the hypothesis and divide the sum by the weights of all the weights (concordance index)

• Consider the criteria for which action a is worse than action b, choose the highest divergence and divide this divergence by the length of the largest scale used (index of discordance)

• Choose the second highest divergence and divide it by the length of the largest scale (discordance index 2)

Phase 3: Upgrade Thresholds

• Set a tolerance threshold for the concordance indices expressing the minimum concordance required.

• Set a tolerance threshold for the discordance index expressing the maximum discordance tolerated.

• Examine all ordered pairs according to the threshold and retain only those passing through the filter.

Phase 4: Groping and Synthesizing

• If some actions are not outclassing or outclassed, repeat steps 2 and 3 by increasing or decreasing the threshold, weight,

• Choose, if possible, the action that outperforms others in most scenarios

As a result, the ELECTRE method detects the best option of areas among several. Moreover, it can be satisfied with the limited information available and which are generally and easily accessible. Its use is simple and based on two assertions: "agree / disagree"; it is not based on a priori. It is also based on a robustness analysis designed to produce highly synthetic recommendations that are acceptable to most parameters.

The variation in some of the initial parameters (either because of uncertainty or subjectivity) results will not be remarkably modified: since these variations will constitute the scales of the criteria scales, the weight of the criteria, the concordance threshold and the threshold of discrepancy. So the recommendation developed is considered robust.

However, the resulting recommendation is not always the best area. The decision maker must always take into consideration that the core group does not contain the best areas but the most difficult areas to compare and that among these areas is the best option.

Problem Description:

Let Z be the set of Z_i candidate zones for the implementation of a project for the development of industrial zones Z_i varying from Z_1 to ZNz, where Nz is the number of zones.

$i \in \{1, 2, 3, \ldots\ldots \text{Nz} \}$

Each zone Z_i is evaluated according to the criteria C_j. The criterion C_j varying from C_1 to C_{Nc}. Nc being the number of criteria:

$j \in \{1, 2, 3, \ldots\ldots \text{Nc} \}$,

Each criterion has the following weighting of importance:

The upgrade method

Criteria	C_1, C_2, ….C_i, ….C_{Nc}
Weight	W_1 ,W_2 …Wi …W_{Nc}

The evaluation Z_iC_j of each zone Z_i on each criterion C_j, compares the different criteria on five levels of overall satisfaction:

Table-1

Very Beneficial	VB
Beneficial	B
Neutral	N
Adverse	A
Severely Adverse	SA

Experts attribute an intensity ZiCj = gij which takes the values (VB, B, N, A or SA) and which represents the true preference of each zone relative to each criterion. A first comparison matrix M1

$$M1_{(Nz,Nc)} = \begin{pmatrix} g_{11} & \cdots & g_{1Nc} \\ \vdots & \ddots & \vdots \\ g_{Nz1} & \cdots & g_{Nz\,Nc} \end{pmatrix}$$

The concordance index for two choices of zones a and b is denoted by C (Zi, Zk), between 1 and 0, it measures the relevance of the assertion "Zi surpasses Zk", as follows:

$$C(\mathrm{Z_i}, \mathrm{Z_k}) = \frac{\sum_{\forall j: \mathrm{g_j}(Z_i) \geq \mathrm{g_j}(Z_k)} W_j}{W}, W = \sum_{1}^{Nc} W_j$$

We obtain the matrix of concordance:

The discordance index D is defined by:

$$\mathrm{D}(\mathrm{Z_i}, \mathrm{Z_k}) = 0 \; \forall j, \mathrm{g}_j(Z_i) \geq \mathrm{g_j}(Z_k)$$

if not

$$D(\mathrm{Z_i}, \mathrm{Z_k}) = \frac{1}{\delta} \max \left[g_j(\mathrm{Z_k}) - g_j(\mathrm{Z_i}) \right]$$

this makes it possible to obtain:

$$D = \begin{pmatrix} \mathrm{D}(Z_1 Z_1) & \cdots & \mathrm{D}(Z_{Nz} Z_1) \\ \vdots & \ddots & \vdots \\ \mathrm{D}(Z_1 Z_{Nz}) & \cdots & \mathrm{D}(Z_{Nz} Z_{Nz}) \end{pmatrix}$$

With δ is the maximum difference between the same criterions for two given zones.

Model development:

In order to identify the criteria for the selection of industrial zones, we submitted a questionnaire to 32 companies working in several industrial areas, the aim being to enrich an initial list and to evaluate the weight of each criterion in their decisions in a zone or other.

List of identified industrial area selection criteria

Table-2: Selection criteria

Criteria	Designation
Area	•Total area, • Area occupied, • reserved for infrastructure, •unusable, • Available and expansion possibilities.
Location and general infrastructure:	• Nearest urban center, • Nearest highway, • The closest road and its importance, • Connection or not to the track, • proximity or non-proximity of the waterway, • nearest airport; • Availability of public transport
Internal equipment	• Aisles (width and lining), •Public lighting, • Water (quality, volume available and price), • Connection to sewage networks (sewers ..) •Electricity, •Natural gas,
Urban development prescriptions	• Type of buildings (Levels), • Coefficient of ground right-of-way (Construction area total area of the lot) • Conveniences (restaurants, supermarket, bank ...)
Price	• Price per m² • Cost of MO
Occupation	• Number of establishments already installed, • Nature of investments, • Type of activities, • Nationality of enterprises
Population	•Effective, •Middle age, •% male / female •% level of qualification (Workers, masters, managers) •active population, • Unemployed population
Taxation	Tax incentives and exemptions
Means of communication	• Telephone network, •Internet connection (Cable / Fiber Optic / 4G)

We submitted the list of criteria to the managers of the companies who selected the criteria according to their relevance and the availability of information about the industrial zones.

Table-3: The list of selected criteria

Criteria	Designation
C_1	Available area
C_2	Distance to nearest motorway,
C_3	Distance to nearest national road
C_4	The nearest airport;
C_5	Distance to nearest port
C_6	Distance from railway station
C_7	Availability of public transport
C_8	Availability Fire Station
C_9	Availability of water treatment plant

C_{10}	Price per m² (in dh)
C_{11}	Active population,
C_{12}	Connection (Cable / Fiber Optic / 4G)

Table-4: Weight of criteria

C_i	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
W_i	9	15	12	6	15	6	3	3	2	18	2	9

Table-5: List of candidate zones for the project:

Zone	**Désignation**
Z_1	AlHoceima-Ait Youssef or Ali
Z_2	Mohammedia
Z_3	Casa-Nouaceur (aero)
Z_4	El Jadida (Jorf Lasfar)
Z_5	Meknes
Z_6	Settat
Z_7	Tanger automotive city
Z_8	Tangier-Zone Franche
Z_9	Oujda free zone
Z_{10}	Tetouan
Z_{11}	Kenitra

Table-6: Weighting of criteria and evaluation of each area in each criterion:

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
Z_1	12,71	176	0	16	135	126	non	non	non	350	21342	non
Z_2	6,3	0	2	43	6	5	oui	oui	non	1650,2	80618	oui
Z_3	5,7	8	2,5	5	30	2	non	oui	non	1400	7461	oui
Z_4	34,32	27	0	127	0	10	non	oui	oui	350	75869	oui
Z_5	50,72	0	2	60	244	85	non	non	oui	518	185195	non
Z_6	4,98	2	0	40	60	1	oui	oui	non	400	51159	non
Z_7	25,02	10	0	60	30	40	non	non	oui	657	102754	oui
Z_8	20,32	5	0	3	56	12	oui	oui	oui	600	102754	oui
Z_9	35,63	10	0	1	120	10	non	non	oui	300	170440	oui
Z_{10}	0,9814	30	2	60	40	60	oui	non	non	1800	142655	oui
Z_{11}	44,66	14	0	50	160	2	oui	non	oui	400	160166	non

We adopted the system of scoring of Guigou (1971) [37]:

Table-7: System of scoring

Very Beneficial	VB	20
Beneficial	B	15
Neutral	N	10
Adverse	A	5
Severely Adverse	SA	0

Table-8: Score by area by criteria

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
Z_1	N	SA	VB	B	SA	SA	SA	SA	SA	B	A	SA
Z_2	A	VB	B	N	B	B	VB	VB	SA	SA	N	VB
Z_3	A	B	B	VB	N	VB	SA	VB	SA	A	SA	VB
Z_4	B	A	VB	SA	VB	N	SA	VB	VB	B	N	VB
Z_5	VB	VB	B	SA	SA	SA	SA	SA	VB	N	VB	SA
Z_6	A	VB	VB	N	A	VB	VB	VB	SA	B	A	SA
Z_7	B	B	VB	A	N	A	SA	SA	VB	N	B	VB
Z_8	B	B	VB	VB	A	N	VB	VB	VB	N	B	VB
Z_9	B	B	VB	VB	SA	N	SA	SA	VB	VB	VB	VB
Z_{10}	SA	A	B	A	N	A	VB	SA	SA	SA	B	VB
Z_{11}	VB	N	VB	A	SA	VB	VB	SA	VB	B	VB	SA

This scoring system leads to a second table of weighted information, illustrated below:

Table-8: Weighted Scoring

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
Z_1	10	0	20	15	0	0	0	0	0	15	5	0
Z_2	5	20	15	10	15	15	20	20	0	0	10	20
Z_3	5	15	15	20	10	20	0	20	0	5	0	20
Z_4	15	5	20	0	20	10	0	20	20	15	10	20
Z_5	20	20	15	0	0	0	0	0	20	10	20	0
Z_6	5	20	20	10	5	20	20	20	0	15	5	0
Z_7	15	15	20	5	10	5	0	0	20	10	15	20
Z_8	15	15	20	20	5	10	20	20	20	10	15	20
Z_9	15	15	20	20	0	10	0	0	20	20	20	20
Z_{10}	0	5	15	5	10	5	20	0	0	0	15	20
Z_{11}	20	10	20	5	0	20	20	0	20	15	20	0
W_i	9	15	12	6	15	6	3	3	2	18	2	9

The concordance matrix is obtained by calculating the agreement indicators between each pair of zones as follows:

$$C(Z_i, Z_k) = \frac{\sum_{\forall j: g_j(Z_i) \geq g_j(Z_k)} W_j}{W}, W = \sum_{1}^{Nc} W_j$$

Table-9: Concordance matrix

MC	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}
Z_1	-	0,55	0,59	0,94	0,64	0,85	0,76	0,82	1	0,55	0,94
Z_2	0,47	-	0,65	0,7	0,58	0,74	0,52	0,64	0,58	0,46	0,52
Z_3	0,46	0,7	-	0,73	0,61	0,7	0,85	0,79	0,76	0,43	0,52
Z_4	0,39	0,44	0,42	-	0,37	0,63	0,58	0,67	0,82	0,35	0,73
Z_5	0,72	0,69	0,54	0,74	-	0,87	0,74	0,74	0,76	0,54	0,85
Z_6	0,58	0,64	0,5	0,7	0,37	-	0,49	0,61	0,58	0,31	0,61
Z_7	0,42	0,57	0,57	0,77	0,52	0,63	-	0,85	0,85	0,44	0,61
Z_8	0,3	0,51	0,54	0,74	0,46	0,72	0,82	-	0,79	0,29	0,52
Z_9	0,33	0,51	0,57	0,59	0,49	0,54	0,68	0,8	-	0,3	0,52
Z_{10}	0,5	0,98	0,95	0,89	0,61	0,74	0,97	0,85	0,82	-	0,76
Z_{11}	0,63	0,51	0,54	0,59	0,55	0,87	0,62	0,65	0,82	0,36	-

We obtain the discordance matrix by calculating the discordance indicators between each pair of zones as follows:

$$D = \begin{pmatrix} D(Z_1 Z_1) & \cdots & D(Z_{Nz} Z_1) \\ \vdots & \ddots & \vdots \\ D(Z_1 Z_{Nz}) & \cdots & D(Z_{Nz} Z_{Nz}) \end{pmatrix}$$

With δ Difference on a criterion

$$\delta = \max(C_i)_{1 \leq i \leq Nc} \left[g_j(Z_k) - g_j(Z_i) \right]$$

$$D(Z_i, Z_k) = \frac{1}{\delta} \max \left[g_j(Z_k) - g_j(Z_i) \right]$$

Table-10: Discordance matrix

MD	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}
Z_1	-	1	1	1	1	1	1	1	1	1	1
Z_2	0,75	-	0,5	1	1	0,75	1	1	1	0,25	1
Z_3	0,5	1	-	1	1	1	1	1	1	1	1
Z_4	0,75	1	1	-	0,75	1	0,5	1	1	1	1
Z_5	0,75	1	1	1	-	1	1	1	1	1	1
Z_6	0,25	1	1	1	1	-	1	1	1	1	1
Z_7	0,5	1	1	1	0,25	1	-	1	0,75	1	1
Z_8	0,25	0,5	0,5	0,75	0,25	0,5	0,25	-	0,5	0,25	0,5
Z_9	0	1	1	1	0,25	1	0,5	1	0	1	1
Z_{10}	0,75	1	1	1	1	1	1	1	1	-	1
Z_{11}	0,5	1	1	1	0,5	1	1	1	1	1	-

RESULTS

The over-classification relationship is defined by comparing the match with the specified matching threshold and the discrepancy with the specified mismatch threshold:

With c and d, respectively, concordance threshold and discordance threshold.

Table-11: Threshold of concordance

	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}	Z_{11}
Z_1	-	0,55	0,59	0,94	0,64	0,85	0,76	0,82	1	0,55	0,94
Z_2	0,47	-	0,65	0,7	0,58	0,74	0,52	0,64	0,58	0,46	0,52
Z_3	0,46	0,7	-	0,73	0,61	0,7	0,85	0,79	0,76	0,43	0,52
Z_4	0,39	0,44	0,42	-	0,37	0,63	0,58	0,67	0,82	0,35	0,73
Z_5	0,72	0,69	0,54	0,74	-	0,87	0,74	0,74	0,76	0,54	0,85
Z_6	0,58	0,64	0,5	0,7	0,37	-	0,49	0,61	0,58	0,31	0,61
Z_7	0,42	0,57	0,57	0,77	0,52	0,63	-	0,85	0,85	0,44	0,61
Z_8	0,3	0,51	0,54	0,74	0,46	0,72	0,82	-	0,79	0,29	0,52
Z_9	0,33	0,51	0,57	0,59	0,49	0,54	0,68	0,8	-	0,3	0,52
Z_{10}	0,5	0,98	0,95	0,89	0,61	0,74	0,97	0,85	0,82	-	0,76
Z_{11}	0,63	0,51	0,54	0,59	0,55	0,87	0,62	0,65	0,82	0,36	-

Table-12: Threshold of discordance

	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z11
Z1	-	1	1	1	1	1	1	1	1	1	1
Z2	0,75	-	0,5	1	1	0,75	1	1	1	0,25	1
Z3	0,5	1	-	1	1	1	1	1	1	1	1
Z4	0,75	1	1	-	0,75	1	0,5	1	1	1	1
Z5	0,75	1	1	1	-	1	1	1	1	1	1
Z6	0,25	1	1	1	1	-	1	1	1	1	1
Z7	0,5	1	1	1	0,25	1	-	1	0,75	1	1
Z8	0,25	0,5	0,5	0,75	0,25	0,5	0,25	-	0,5	0,25	0,5
Z9	0	1	1	1	0,25	1	0,5	1	-	1	1
Z10	0,75	1	1	1	1	1	1	1	1	-	1
Z11	0,5	1	1	1	0,5	1	1	1	1	1	-

Setting the concordance threshold c to 0.8 and the discordance threshold d to 0.3, the only options outside the kernel are Z7 "TANGER AUTOMOTIVE CITY" and Z8 "TANGER FREE ZONE" that outperform the other zones.

DISCUSSION

Despite the limitation of the number of candidate zones to 11 and the limitation of the number of criteria to 12, the solution is far from being intuitive or predictable. The attractiveness of the Tangier Free Zone and Tangier automotive city can be explained by their proximity to the port of Tangier Med and their connections with the motorways and the railway station. However, the availability of land at an attractive price and the availability of human resources and its proximity to the economic capital are not enough to select the SETTAT area.

The developed model allows for the weighting of the criteria for identifying areas that combine the key factors of success and installation conditions expressed by end customers (industrial firms) and which objectively outperform their rivals. It can help policy-makers and decision-makers locate areas of greatest interest and attractiveness for investors. In practice this choice is often made on social and political considerations without taking into account all the needs of industrialists. This explains the number of unoccupied industrial areas and poor occupancy, a simple failure of telecommunication networks, the Internet or a shortage of means of transport for the working population can make an area unusable despite the investments and the will of the politicians.

CONCLUSION

This work provides a comprehensive and complete framework for the location of industrial areas.

The choice of these zones is generally made taking into account several geographical, urbanistic, demographic and logistical parameters. This paper presents a multi-criteria decision model for the location of these industrial zones. It contributes by offering an updated list of all the parameters to be taken into consideration and a practical case study.

It is applied to the networks of industrial zones of the Kingdom of Morocco involving 32 companies in the identification, selection and weighting of factors and decision parameters.

The model can be adapted according to the company profile and its activity. It can select the appropriate indicators from the list provided according to its field of activity and weight them according to its strategy. The availability of more data could greatly improve the accuracy of the results.

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