Using geographic information systems in distribution network localization: Case study of the distribution network of the Renault brand in Setif province

استخدام نظم المعلومات الجغرافية في توطين شبكة التوزيع:

دراسة حالة شبكة توزيع علامة رونو في ولاية سطيف

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Abstract:

This article aims to study how GIS and spatial analysis techniques can be utilized to find the best localization of a Renault point of sale network in Setif province, relying on the description of the maps under study, which implemented by Arc GIS to access the distribution network in the province.

The study has found that Renault is relying on the localization of its distribution network to select sites overlooking the main roads in order to better reach its customers.

Keywords: Geographic information system; Localization; Distribution network.

JEL Classification Codes : Z0, R3, D3

ملخص:

يهدف هذا المقال إلى دراسة كيفية استعمال نظم المعلومات الجغرافية وتقنية التحليل المكاني في إيجاد التوطين الأمثل لشبكة من نقاط البيع ، تمت الدراسة على نقاط البيع الأربعة المكونة لشبكة لعلامة رونو في ولاية سطيف، إذ اعتمدنا على وصف وتحليل الخرائط قيد الدراسة والمنفذة ببرنامج *Arc GIS*، كما تم قياس فعالية مواقعها عن طريق برنامج من أجل الوصول إلى شبكة التوزيع المثلى في الولاية.

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وتوصلت الدراسة إلى أن مؤسسة رونو تعتمد في توطين شبكة التوزيع الخاصة بها على اختيار مواقع مطلة على الطرق الرئيسية، من أجل الوصول بشكل أفضل إلى زبائنها.

كلمات مفتاحية: نظام المعلومات الجغرافية، التوطين، شبكة التوزيع.

تصنيفات JEL: D3, R3, Z0

1. INTRODUCTION

Most institutions seek to build strong strategies that can penetrate the market and confront competitors. For decades, these institutions have searched for the optimal way to maintain their market position and also to better reach their current and prospective clients.

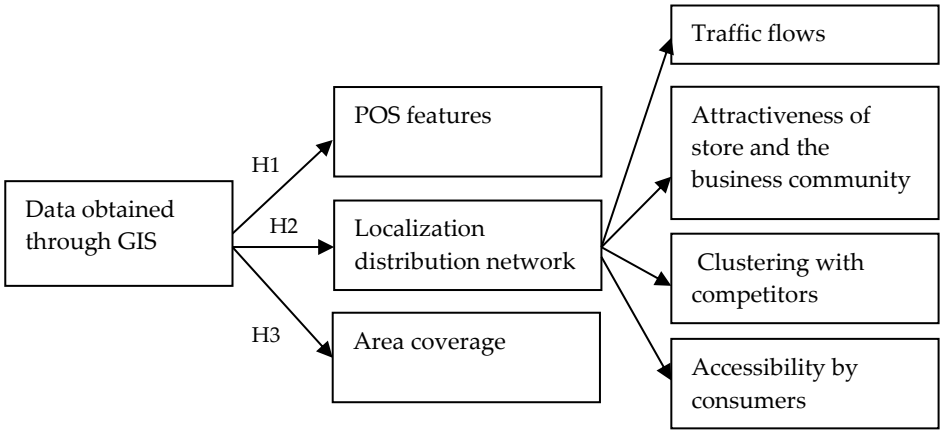
GIS is one of the most important software used in this time, for the reason that it contains the technology that helps analyzing data and drawing conclusions. The use of GIS as an essential information and marketing tool compels marketing and sales managers to change their marketing strategies and ways to accomplish advertising campaigns by focusing on this new method that will enable organizations to expand their marketing activities, in equal terms, and it will allow direct contact with customers by focusing on marketing for specific market segments, rather than overall marketing, in order to accurately identify target customers.

Thus, the main question is: how can GIS data are utilized to find optimal point selling locality?

To answer this question, the following hypothesis must be tested:

- GIS contributes to the provision of geographical data to study the characteristics of POS locations of Renault's network;
- GIS contributes to the provision of the geographical data needed to determine the POS terminals of Renault's network in Setif province;
- GIS contributes to the provision of the geographical data needed for optimal coverage by Renault's network of the area under study in order to reach consumers.

Figure 1. Study optimal model



Source: Prepared by the researchers using literature review

2. Literature review

The huge amount of information renders it very difficult to deal with, absorb and benefit from, unless it is organized, classified, indexed, digitized and stored in databases that can be manipulated and utilized without compromising accuracy or storage. In order to develop methods and systems to store and manage this information, many types of information management systems have emerged, including geographic information systems, which were not limited to use only in geographical areas, but they extended their impact to other fields, such as marketing science, and were used in marketing processes, specifically in the study of product distribution networks.

2.1. What is GIS?

GIS can be defined as "Computer system hardware, software, and processes designed to enable the collection, management, processing, analysis, modeling and representation of spatial data for information that contributes to decision-making." (Sanga & i Bakary, 2007).

The Cambridge Business Dictionary defines GIS as a "Computer system that stores, organizes and studies data related to the location, area, or size of certain objects." (cambridge, 2016).

According to the two previous definitions, GIS provides technology that helps analyzing data and drawing conclusions. GIS is based on geographical data obtained from several sources, it also helps in the development of strong databases, including market data, in which the organization operates, so that it can choose the best locations to localize its branches, thus guaranteeing the best customer access.

2.2. Outputs & Benefits of GIS

The users of GIS can perform many technical analyzes that were technically impossible in the past (Johnston, 2005):

- The analysis of spatial forms, where maps of different phenomena are added to determine mutual relations. This may be the direct linkage of phenomena between any point of the sale and area;

- Spatial distribution analysis; using information fields largely to describe and analyze the spread of different phenomena.

The GIS contains several types of geographical outputs, which are organized by subject matter, often in the form of layers, each layer containing objects of the same type (roads, buildings, waterways, provincial boundaries, institutions, etc.) and each body has a description and a form (body geometry) (Messaoudi, 2015).

2.3. Choosing an optimal commercial localization

GIS plays an important role in the spatial analysis process, translating this role into the optimal choice of POS sites. The choice of these sites is an important decision in the organization as it leads to an optimal access to consumers through the modeling of phenomena on the network, taking into account the different settlement models through which the theoretical model of this settlement is chosen.

Thus, regardless of the type of business considered, choosing a good localization is undoubtedly one of the important decisions that the path takes, where the localization of a point of sale somewhere is a fixed investment in the long term, and reflects whether the choice this place is good or bad on the level of sales and market share, especially on the profitability of activity, and also when the level of competition is large. Moreover, it can re-review prices, reorient services, and change goods. In contrast, bad resettlement is a punitive and sometimes irreversible decision. (Baray, Localisation commerce

multiple: une application du traitement du signal du modèle p-médian au développement d'un réseau de magasins de produits biologique, 2015).

Commercial settlement has been defined by many researchers as: "the mobilization of certain resources: site studies, purchase or lease of land, location, acquisition of furniture, recruitment and training of personnel, etc. with a view to achieve a better site for the establishment of the institution" (Baray, Optimisation de la localisation commerciale: une application du traitement du signal et du Modèle p-médian, 2003).

The stage of searching for a commercial settlement begins when the institution seeks to identify the market in which it wants to settle. Furthermore, the exact number of POSs established must be specified in order to determine the market's saturation of the product or service provided and the financial capacity. The first type of endemism theory is based on the homogeneity of commercial attraction, as one of the main criteria for these models is distance and therefore it seeks to obtain the nearest site to the masses of customers in order to attract the largest number (Liarte, Comment localiser les unités de son réseau de distribution : entre évitement de la concurrence et recherche de proximité, 2003).

The advantage measured from commercial settlement in undisclosed locations is measuring commercial gravity along the customer trade area**.** The farther away from the point of sale, the weaker the gravity and vice versa, and also the measure of the spatial behavior of the consumer around their place of residence and their preoccupation with the distance traveled provides the goods and services desired. For these reasons, it will reduce the distance of navigation. Hence, geographical analyzes of the environment and competitions have a significant impact on the attractiveness of the point of sale. Prior studies of commercial settlement relate to the delimitation of the area studied first, and then to an economic valuation of the point of sale within that area. The classic concept is that customer presence is made up of a number of subdivisions where consumer ratings are assessed for each region. In parallel, by defining the theoretical market for each region, the researcher is able to assess the overall potential market for the point of sale

and compare it with theoretical markets in terms of real influence rates in each region (Cecile, Bruno, & Nicolas, 2001).

2.4. Data obtained from GIS

There are three types of data that can be obtained and modeled through geographic information systems, which contribute to the study of the current and expected localization of a POS network: first, the characteristics of the POS; secondly, the localization of the networks which consists of traffic flows and aggregation with competitors, in addition to the attractiveness of the store and commercial gatherings; and finally, the coverage of the distribution network in the area to be studied.

2.4.1. POS features

POS is an image store or a chain store that expresses the shape, strategy and size of the trade. This image affects the value of the products offered and the store sales. The performance of the store is also related to the depth of the selection, quality, and level of the service provided, prices and promotion policy. Likewise, the size of the store is often indicative of the available range, level of service, convenience, and a lower risk of depletion. Thus, it may be positively related to the performance of the store.

2.4.2. Localization of the distribution network pillars

- Traffic flows is the study of interactions between travelers (including pedestrians, cyclists, drivers and their vehicles) and infrastructure (including highways, signage, and traffic control devices), with the aim of understanding and developing an optimal transport network with efficient movement of traffic and minimal traffic congestion problems.
- The attractiveness of the store and the business community is the most important factor in determining the performance of the distribution network including the store's location and both social and demographic character of the catchment area; the localization of points of sale can significantly affect the commercial attraction of the trade zone and vice versa.
- The clustering with competitors: the term clustering generally reflects the existence of different types of cities, as evidenced by the stable urban hierarchy in most countries, since cities can be specialized in a

few industries. By contrast, large cities are highly diverse and receive a large number of industries that are not always directly linked to one another. At a more detailed level, the clustering phenomena within cities are manifested in the form of commercial areas or city centers. On the other hand, restaurants, cinemas or establishments offering similar products tend to gather in the same neighborhood, if not on the same street, or in large shopping malls (Masahisa & Jacques, 2003).

In order to try to find positive points for the bloc, the company tries to combine the institution with the competitors by following one of three policies to settle in a profitable way as well as to be protected against the risk of its competitors, to be near the competitors, to cooperate with them (exchange of benefits and interests), to benefit or to obstruct them (Liarte, Mutualisme, prédation et parasitisme : la concurrence comme critère de choix de la zone d'implantation, 2006).

All these factors contribute significantly to determining the appropriate location for the settlement of the institution's distribution network.

- Accessibility by consumers: the consumer must be able to approach, penetrate, transit and exit from the point of sale during their first visit or subsequent visits through the arteries of movement, which is often in roads. Moreover, they must have the ability to absorb traffic from the sources of all destinations, the number of intersections and routes, the acceptable number of access routes, the speed at which these roads are allowed, and traffic lights (plates, notes, red lights, arrows, etc.). (Marc, 2006); The degree of congestion of the line to the store: pedestrian traffic (number of people and type of people) or vehicles (number of vehicles, peak hours, etc.); The possibility of finding a place to stop easily: the number of parking spaces, the distance to the point of sale, the type of position (covered or covered), the possibility to find it free or not; the availability of public transport: a factor that is partly important for consumers who do not own cars or do not want to venture in areas with heavy traffic and poor access to a position (Marc, 2006).
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2.4.3. Area coverage

The main issue in building the distribution network is network's ability of reaching all places where target audience is located through marketing strategy and pay products to customers. In fact, only certain distributors in specific or neglected areas can shift a large share of customers toward them. This leads to covering only a part of the market and a possible loss of sales. The overall performance of the organization is also affected by the choice of a distributor who does not pay offers toward the humble. Therefore, the organization must know which channels are most frequently used by the target audience in order to achieve their purchases. Thus, the frequency of several distribution channels affects the trends and development of consumer purchasing habits (Claude, 2008).

2.5- Spatial analysis of distribution networks through GIS

Spatial analysis of distribution networks includes analyzing the structural characteristics of these networks by using statistical indicators to describe and analyze the spatial data of the phenomena and selecting the most suitable ones for the study. It also includes analysis of both linear and pictorial data derived from geographic information systems that allow comparison distribution networks among them. In order to study the structural characteristics of distribution networks, a variety of indicators can be used. These indicators come from the study of road networks that are associated with a partial importance of geographic distances, for example, spacing indicators (Lhomme, 2012).

3. Methodology

The study was conducted on Renault's distribution network in Setif province, where its network consists of four (4) points of sale: CCN Auto, Fahmi Auto, Renault El-Eulma and Renault Truck, which are distributed in various parts of Setif province: three in Setif city and one in el-Eulma city (details will be discussed later). These points are related to each other through three types of flows: cash flows, communication flows and commodity flows. Because of these flows, the points are interconnected, which gives them the status of the network.

In order to process the subject, the data was collected through geographic maps using Arc GIS. It is an integrated system for collecting,

organizing, managing, analyzing, transmitting and disseminating geographic information. It is also a leading platform in the world for the development and use of geographic information systems (GIS).

The information are presented through maps created using Arc GIS, which is the end product of the GIS business as well as a tool used in this work. The Arc GIS map is an interactive window where people can view, explore, analyze, and update geographic information. The user can also create maps not only to display information, but also to find and understand trends and relationships, conduct analysis and modeling to solve specific problems, collect data and communicate among ideas, plans and designs. These data were analyzed using a **spatial analysis technique** that will be discussed in detail.

Spatial analysis of distribution networks involves analyzing the structural characteristics of these networks by using statistical indicators to describe and analyze the spatial data of the phenomena, selecting the most appropriate ones for the study, and also analyzing the linear and the pictorial data, which allows the comparison of the distribution networks among them.

In order to study the structural characteristics of distribution networks, a variety of indicators can be used. These indicators come from the study of road networks that are related to the partial importance of geographic distances, for example, the divergence indicators. The average dimension of a graph can be measured by means of a medium set of short paths between each couple of the graph's nodes. Measuring this index at a peak, in a given measurement, gives the level of access to this summit to the whole chart. At the same time, this indicator is only applicable in the associated charts. It is therefore suggested to use the opposite of distances. Also, the term effectiveness is often used. These indicators allow, in some way, to evaluate the **effectiveness** of a network, because the smaller the average spacing index, the more **efficient** the network is considered (Lhomme, 2012).

4. Results

In this section, the GIS output of Arc GIS was distributed to Renault's distribution network of Renault brand in Setif province, where the results

were addressed in three aspects, based on the theoretical view of the article: the characteristics of the network's POS sites, Renault in Setif, and finally cover the network through POS. The study of these three elements helps to understand the structure of the distribution network and the factors influencing its location in its present form, and contributes to its subsequent re-modeling in the event of a defect within it, in order to reach the customers and meet their needs.

4.1. Regional governance and distribution

Renault has an extensive distribution network in Algeria with its presence in most provinces, especially in the east.

Figure 2. Distribution of sale's points of the Renault network along the northeast of country

Source: Taken from the company's website (www.renault.dz/)

As shown in the map above, Renault has points of sale in most provinces of the Northeast Region, the only province where there is no Renault distribution network is Mila.

Considering the specificity of each area, most of the points of sale are located on the main roads of each province so that they are visible to customers and easily accessible to customers.

4.2. Characteristics of POS Locations

The Renault network in Setif province consists of four points of sale distributed in different regions of Setif province, as follows:

4.2.1. CCN Auto

It located in the area of Ain-Sfaiha along with the national road No. 28, link between the provinces of Setif and Batna.

4.1.2. Fahmi Auto

It located in the activities and storage area of Setif City, along with the national road No. 5, linking the two cities of Setif and El-Eulma.

4.2.3. Sarl Auto El-Eulma

This point is located in the industrial area of El-Eulma city along with the national road No. 05.

4.2.4 Global Motors

It located in the Al-Bez area along with the National Road No. 05. The location is isolated and fairly remote.

From the description above, it is noted that POS stands in line with the main roads in the province. Hence, as a conclusion, the resettlement strategy of the Renault Foundation aims to localize points of sale in areas known, prominent and accessible to consumers.

4.3. POS pillars at the Renault network in Setif province

Cars manufacturers, as all product suppliers, need outlets to be able to welcome potential customers and show their cars, thus they need to create a network of points of sale. As it is known, this is done in places where new cars are generally sold, as well as garages where cars are repaired. Some of these garages are independent, while others operate under the franchise system. The Renault network relies on this kind of distribution, in order to attract more customers, use the brand name and improve the image of the manufacturer, which is often recognized and supported by a significant market segment, placing it in a state of trust.

According to the above description of the POS terminals of the Renault network in the Setif province, and based on what was discussed in the theoretical aspect, the localization of Renault network in the Setif province depends on three pillars:

4.3.1. Flows

The flows mean the traffic and main roads leading to the point of sale, which allow a large flow of vehicles. As discussed previously, all the points

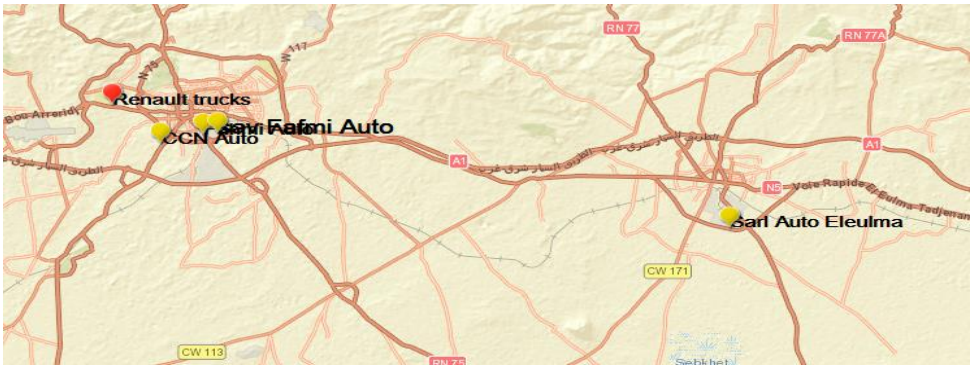
of sale of the Renault network are settled on the main roads connecting the major cities, for the following reasons:

- In order to find an excellent location and a strategic point that allows the point of sale to be visible to customers so that they can discover it easily and quickly;

- Pedestrian flows or road flows depending on the geographical location of the enterprise and the extent to which these points of sale are located in the industrial zones;

- The availability of urban transport to these areas, especially the availability of stations to stop at each point of sale.

Figure 3. Distribution of the Renault network's sale's points along with the main roads of the province



Source: Prepared by the researchers using Arc GIS

From the map above, all the points of sale are located on the main roads of Setif Province, giving them a location that allows them to have good access to their current and prospective customers, and also allows them to be easily remembered.

4.3.2. Attractiveness of the store

Commercial conglomerates attract customers, usually associated with business centers through shopping malls, where they are often built around a well-known shop known as part of the "big retail" trade, which is not necessarily "supermarkets" (food distribution), but can be a some sort of a trade that attracts a mass of potential customers. The company Sarl Auto El-Eulma is located in the industrial area of the city of El-Eulma as shown in the following figure:

Figure 4. Influence of the industrial zone's attraction on the point of sale located in the city of El-Eulma

Source: Prepared by the researchers using Arc GIS

The point of sale is located along with the road of the activity and storage area, which is located along the Pazer Sakra area. This area is an extension of the original industrial zone, increasing the commercial attractiveness of the area and thus attracting more potential customers.

CCN Auto is located in the area of Ain-Sfaiha along with the national road No. 28 (as previously mentioned and described in the following figure). It is located near the industrial zone of Setif province, and it is close to the area of activities and storage. Therefore, it has a commercial attraction on three levels, and thus can attract more potential customers.

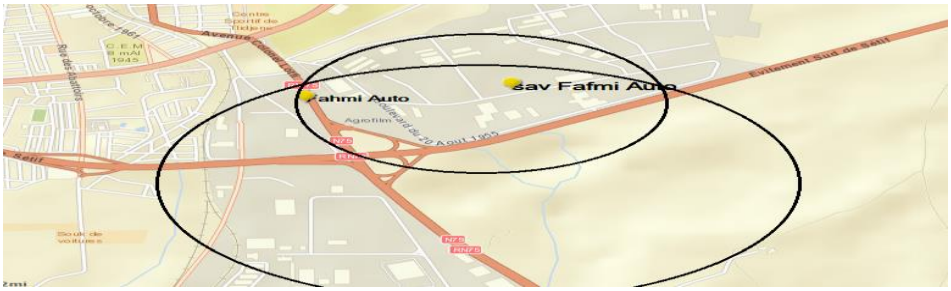
Figure 5. The impact of the attractiveness of the industrial zone on the point of sale located in the region of Ain-Sfaiha

Source: Prepared by the researchers using Arc GIS

Fahmi Auto is located in the region of activities and storage in the city of Setif. The region has a large commercial attractiveness with 60 active

economic institutions (internal documents of the Real Estate Management Association, 2017) operating in various economic activities.

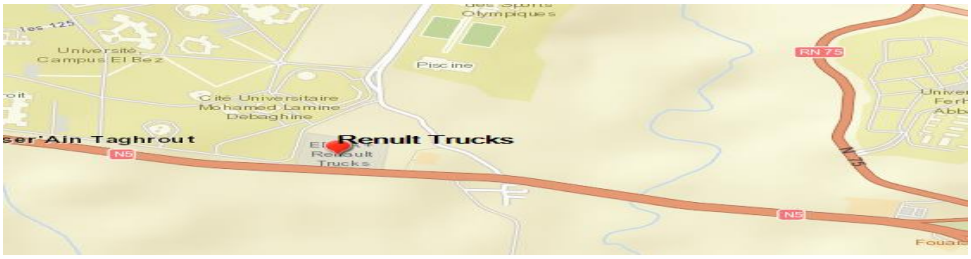
Figure 6. The impact of the industrial zone attraction on the point of sale located in the activities zone and storage in Setif city



Source: Prepared by the researchers using Arc GIS

Renault Trucks is isolated from the economic areas of gravity, with only one institution, EMDA, specializing in the sale of industrial equipment. This point of sale depends on its visual location, which allows customers to access it more easily. Thus, it is based on the attractiveness of the region. This is illustrated in Figure 5.

Figure 7. Isolated location of the POS Renault trucks from economic activities



Source: Prepared by the researchers using Arc GIS

Renault's retail outlets are located in industrial areas, as these areas are characterized by strong commercial attractiveness for customers and investments alike, as Renault's point of sale focuses on the attractiveness of these areas in order to attract customers better.

4.3.3. Accessibility by consumers

In fact, regardless of the point of sale, it should be visible so that customers can mark it easily and quickly through the previous geographical maps. All the points of sale are located along with the main transport routes with public transport to each point, which facilitates the arrival of consumers.

4.3.4. Clustering with competitors

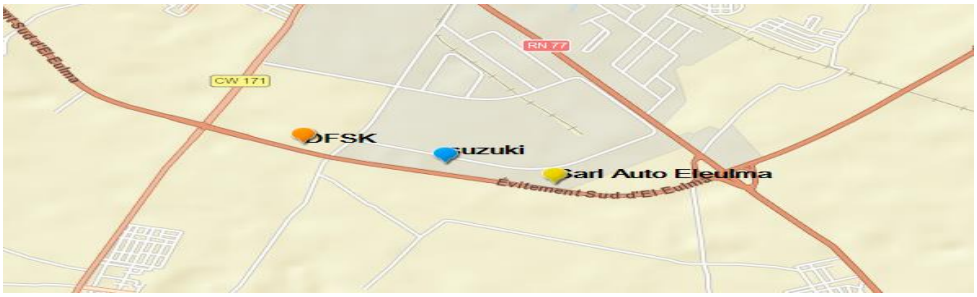
Figure 6 shows the locations of the Renault outlets for direct competitors.

Figure 8. Location of the main direct competitors of the Renault network in Setif

Source: Prepared by the researchers using Arc GIS

Regarding the Auto El-Eulma point of sale, the number of direct competitors is small in the region due to the fact that most of them are concentrated in Setif and around other points of sale for the network (as shown in Figure 7).

Figure 9. The main direct competitors of the Renault network in El-Eulma city



Source: Prepared by the researchers using Arc GIS

In conclusion, the Renault network is located among a large number of direct competitors, indicating that these sites are ideal for an endemic, for the above reasons. Except for the Renault Trucks, which are located apart from the few competitors in the province as a whole.

4.4. Area coverage through POS

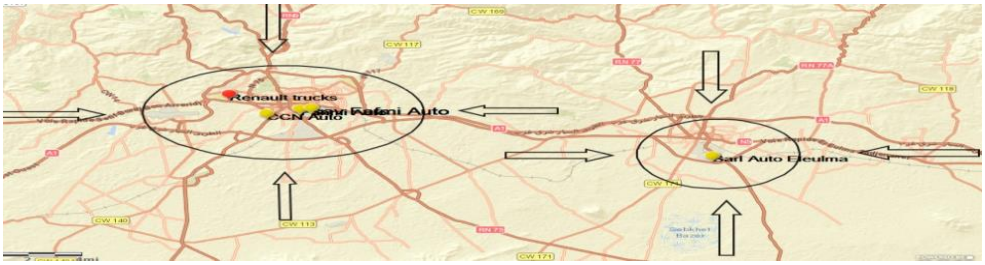
The province of Setif includes 20 municipalities, covering the network of Renault, of which only two municipalities, namely the municipality of Setif and the municipality of El-Eulma, estimated at:

Coverage ratio = Number of covered areas / total number of areas

Coverage ratio = 2/20 = 0.1

The covered area represents only 10% of the province, i.e. 90% is non-covered areas, which is an impediment to the mother institution in order to reach consumers as required. However, the area of operation of these points of sale and the retail product are sacrificing and moving to other points of sale in order to obtain the product. As mentioned above, the two regions are highly commercialized, so they are considered commercial poles on the assumption that commercial gravity phenomena can be modeled in a formula similar to Newton's Floor (as shown in Fig All 8).

Figure 10. Concentration of points of sale in the cities of El-Eulma and Setif



Source: Prepared by the researchers using Arc GIS

The Retail Attraction Act, known as the Reilly Act, states: "In the case of two cities attracting the retail trade of the third city, it means that between the first two cities and the turning point (attracting 50% of the business and customers to each of the first two cities) where they are proportionately proportional to the population, and they are inversely proportional to the square of distance from the two cities to the third city" (Gérard, 1988). The next form is a diagram showing the coverage of the space as well as the direction of the trade attraction of the POS.

There are also statistical indicators or coefficients to describe, summarize and analyze non-spatial data. The analysis of the spatial dimension of the phenomenon is an essential complement to the analysis of the values of the phenomenon itself. Any phenomenon on the surface of the

land needs to be understood to analyze the locations, dimensions and sizes of its parameters.

4.5. Spatial Analysis of the Renault Distribution Network in Setif Province

There are many indicators that measure the spatial central tendency, classified according to their role in any spatial study, but what will be included is one of the indicators or measures of the dispersion and spatial spread, the so-called coefficient "Kei2", which is used to measure the dispersion and the spread of the distribution network.

Most spatial phenomena have a mixture of clustering, randomization, and regular diffusion.

Chi square analysis (Chi square is a Latin character): an indicator that determines whether the spatial distribution of a phenomenon is approaching a certain theoretical distribution. The Chi square analysis is based on covering the study area with a grid of equal squares, then extracting the number of individual phenomenon in each square of this grid and comparing this number with the expected number in the case of regular distribution. The actual Chi value is calculated using Arc Gis:

$$\text{Chi}^2 \cong (16.41)$$

It should be noted that if the distribution of the phenomenon is a regular distribution, the value of the Chi-factor will become zero,(i.e. the closer the value of the coefficient to zero, the actual distribution of the phenomenon close to the theoretical regular distribution). The maximum value of the Chi-square coefficient occurs when all points are grouped into a single square (the province of the aggregated distribution or the center). Since Chi2 ≅ 16.41, which is relatively large, the distribution of points is concentrated in the middle of the province.

5. Discussion

In this paper, the following main results have been reached:

- Geographic information systems contribute to the location of the organization, in terms of:

- Describing the location of each point of sale separately, because the sites of points of Foundation Renault's sale are visible to consumers;

- Concentration located along with major national roads, allowing them to view transport and traffic flows both for private vehicles and public transport;

- The aforementioned site characteristics allow consumers to easily access points of sale;

- Study of the POS network;

- Points of sale's relationship with one another within the network.

- These data obtained from GIS contributes to the identification of the various variables that affect the POS attractiveness of the Renault network, namely:

- Displaying traffic and roads leading to each point of sale within the network;

- Viewing pedestrian and road flows based on geographical maps;

- Examining the availability of transport for the areas under study and providing transport stations at each point of sale;

- The study of commercial gatherings in the cities of El-Eulma and Setif as a reason for the commercial attractiveness of the two cities, which led to their selection as settlement sites. (Points of sale are chosen by the point of sale because Renault operates in the so-called concession system.)

- Information obtained from GIS helps study the Emiratization strategy of the Foundation in general and the Renault Foundation in particular. The resettlement strategy of Renault aims to localize points of sale in known, prominent and accessible areas for consumers.

- Geographic Information Systems (GIS) are based on the development of geographic data as maps, which contributed to the study of the coverage of Renault Foundation's sale's points in the coverage of the region. It was found to be concentrated in only two of the 20 municipalities in Setif province. Only 18% of the remaining municipalities, which account for 90% of the total area, are not covered.

- Through maps modeled by the Arc GIS program, the institutionalization model of the institution, namely the central attraction

theory, specifically the **Reilly** law, has been shown instead of coverage models.

- In addition to the localization of the points of sale on the main roads of the province, statistical spatial modeling shows that it is also located in the center of the province of Setif, which creates a central attraction to the demand for products sold within these points.

5- CONCLUSION

The main objective of the article is focusing on studying the data extracted from the geographic information systems of points' network coming from car sales, namely the Renault network in the province of Setif, and how to contribute to the identification of the optimal location for the settlement of sale's points for the network. The structure and current performance of this network have been presented and the methods used to study the resettlement process have been rapidly changed. The Renault Foundation and the POS form and location are increasingly close to the central attraction model in one city and in the same location. Thus, the creating of distinct selling points provides reliability, interconnection and short-term access.

Based on the findings, the following suggestions were made:

- Expanding the network and increasing coverage in order to reach the potential market segments that cannot move to sale points;

- Focusing on both the product mix and other marketing mix elements such as price, promotion, POS and improvement of after sales services;

- The use of geographical tools and spatial analysis techniques to study future settlement locations, in order to increase the accuracy of decisions related to these places.

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