LOCATION OF NEIGHBORHOOD SHOPPING CENTERS: A CASE STUDY IN RIO DE JANEIRO, BRAZIL

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ABSTRACT

The Shopping Center industry has flourished as a natural development of the urban trade business. In its conception, diversified markets are united in a single area that also provides parking spaces, feeding, and leisure services. The transfer of the market places from congested downtown areas to more accessible locations, stimulated by the widespread use of private cars that developed simultaneously, has defined the success of this industry. Facility location studies are currently employed for locating several types of public services, notably education and health services, and these studies make use of the p-median model, which are solved by exact and heuristic methods, but no similar study for locating shopping centers has been identified in the literature. This article examines the various types of shopping centers and focuses on Neighborhood Shopping Centers, as applied to a region of fast urbanization in Rio de Janeiro that contain residents belonging to the upper income strata. The study reviews the basic methodologies such as the Voronoi Diagrams and the p-Median Model. The population data available, based on the census tract information, suggests the use of the p-median model, but the geography of the region and the condominium style of occupation has inspired the use of a simpler heuristic that keeps track of the Voronoi diagrams. The study proposes six neighborhood shopping centers and identifies their potential locations. The implications of the present proposal in relation to the existing commercial centers are outlined.

Keywords: Location, Shopping Center, p-median, Voronoi diagram

INTRODUCTION

Location is a theme of permanent practical and academic interest that permeates several sciences, such as mathematics, economy, engineering, and operations research. Specific studies of location have always interested human beings as a strategy to preserve safety and welfare. Certainly, the ancient geometers, such as Euclid, pioneered studies for determining the centers of gravities and for identifying physical or geometrical properties. However, Drezner et al. (2002) claimed that the first studies on identifying points in the plane endowed with certain properties are usually credited to Fermat (1601-1665) and, with almost equal frequency, to Torricelli (1608-1647).

Concretely, the location analysis applied to industrial activities, using measures of utility such as production or costs, is regularly attributed to Weber (1957) who, looking to minimize transport costs and reduce costs for the consumer, studied the positioning of an industrial installation, with several inputs and a single marketing consumer.

According to ReVelle and Eiselt (2005), location analysis refers to the modeling, formulation and solution of a class of problems that could be described as positioning facilities in a space. Based on our experience, the abundant studies on the theme are usually made from three perspectives: practical studies, applied studies, and academic studies.

Practical studies concern the location of a specific industrial or commercial activity. In this first perspective, the factors that should be considered in a preliminary evaluation include the materials availability and location, the distance and dimensions of the marketing consumers, means of transport, land availability, climate, pluvial standards, infrastructure, topographical data, power, water and sewerage systems, labor availability and its costs, life conditions, laws and regulations, and tax structures. Certainly, a mistaken decision would cause unrecoverable costs. Evaluations of that nature constitute a favorable knowledge base for specialized consultants whose know-how is not often made public.
Applied studies would be those in which the complexity of the inter-relationships is of such order that the development of explicit models is recommended. The model would emphasize the most relevant elements and ignore a mass of other pertinent information by using what are called simplifying hypotheses. The model produced is useful only if it is capable of pointing out good solutions. Notable examples of applied studies related to locating public services overflow in the modern society, such as schools, maternity centers, health centers, leisure areas, fire-fighters, ambulances, post office, water networks, and sewer systems, inspired by the basic needs of societies, as well as radar systems, communication networks, distribution centers, and oil platforms, inspired by commercial demand or military defense. In fact, the objective of this work is related to this domain of applied studies, and a basic sample of these studies may be found in Galvão et al. (2002), Pizzolato et al. (2004), Monteiro and Pascoal (2005), and Teixeira and Antunes (2008), who examined the location of perinatal units, of public schools, of basic health care facilities, and of a hierarchy of public facilities, respectively.

Academic studies are associated to the development of methods and processes directed to the resolution of complex models, not necessarily concerned with any explicit application. Typically, theoretical studies focus on methodological advances, on the modeling of more complex problems, on the quality of the solution, on the processing time, and on the development of computer resources. It is a fundamental area with remarkable relevance, as noted by the number of articles, congresses, and journals dedicated to the topic.

Considering management science, or operations research, as a more restricted expression, the available literature on location is unlimited, but the foremost prestige is associated with the theoretical studies, followed by the applied studies, and less prominence associated with the practical studies. The first methodologies were concerned with the location of a single installation, but with computer and modeling resources advances, the methodologies became directed to the simultaneous location of several facilities. The immense literature on the theme makes futile any attempt at a general literature review, even if labeled as representative. In any case, we must mention the recent works of ReVelle and Eiselt (2005), Melo et al. (2009), and Reese (2005), which present extensive bibliographical reviews. In addition to these references, in any search system, the word “location” will match an immense number of theses, dissertations, scientific articles, editorials, and books, highlighting the importance of the theme for many areas, such as administration, economy, engineering, and computer science.

The present work aims to study the location of Neighborhood Shopping Centers, which are designed to support shoppers living in limited geographical areas, which, according to our investigations, have never been the object of published research. Certainly, the shopping center, as a general concept, developed in the United States, and its location dictated by the intersection of main highways. The practical location perspective, as described above, would emphasize the customer’s needs, family income, accessibility and traffic flow in the neighboring highways. However, this intuitive approach applies to locating one single venture and might ignore the existence of several types of shopping centers. Additionally, this approach would not address the question of locating a network of shopping centers.

This study is organized as follows: Section 2 presents several types of shopping centers and highlights the importance of the Neighborhood Shopping Centers; Section 3 summarizes some of the technical procedures for public facility location, namely the Voronoi diagrams and the p-median model; Section 4 describes the district of Barra da Tijuca, in which the case study was conducted, highlighting its physical, demographic and urban characteristics, and proposes the ideal location based on a heuristic methodology; Section 5 elaborates on the implications of the present proposal over the existing shopping center network; finally, Section 6 summarizes the conclusions of the study.

**SHOPPING CENTERS**

**Development of Trade**

A possible definition for a shopping center, not fully endorsed by the present work, as justified further on this section, may be found in http://pt.wikipedia.org/wiki/Shopping_Center: “a shopping center is a business establishment specifically built to cover a center of purchases that presents a diversified market, feeding area, leisure area, parking and high comfort level services, such as air conditioned area, lifting stairs, elevators, and safety. The type of anchor stores, the amount of stores and the fact of existing owned stores with rented stores also characterize that category.”

Going a step back in human history, early merchants used to walk to their clients or would select their places of business for their own convenience, without much concern about the neighborhood. With the growth of cities, however, they noticed the advantages of establishing themselves at places that presented a high concentration of activities. Grouped together, the merchants could attract more buyers, jointly benefiting
consumers and their own trade. This evolution determined permanent constructions in order to shelter the local trade. Later, those constructions developed to assume the form of galleries, usually located in the center of the cities.

At the beginning of the twentieth century, two scenarios appeared in the western world, especially in the United States, which were at the origin of the current expansion of the Shopping Centers, namely: intense urbanization and the widespread use of the automobile. The overall progress brought by the end of the Second World War determined the evolution of this industry. The progressive deterioration of the urban centers and the consumers’ preference for parking their cars close to the commercial centers brought new challenges for assisting the clients.

The precise origin of shopping centers is certainly controversial, considering the type of business model that is known today, but the first building with characteristics close to the current ones began in the USA in 1907, by Edward H. Bouton, showing architectural uniformity, centralized administration by the entrepreneur, congregation of stores of different branches, and parking for carriages.

In 1931, the first enterprise in the same style as the present day shopping centers appeared in Dallas, Texas – USA. It was the Highland Park Village, which, in agreement with the Urban Land Institute (ULI), became a standard for shopping centers in America. In 1956, the Southdale Center in Edina, Minnesota – USA was built, with an all enclosed construction due to the rigorous winter; its architectural model was adopted by all future shopping centers, not only in their architecture, but in the parking lots design. Regarding the open mall, its pioneer was the King of Prussia, in Philadelphia, built in 1958, whose success was attributed to the perfect alignment of the architectural content with the space. In the sixties, architectural variations and innovations appeared in the market, with a great expansion in European countries.

Certainly, the great urban agglomerates of Brazil are not equivalent to those in North America because the car is not accessible to all and the congested roads do not stimulate long drives for routine shopping. However, Barra da Tijuca, in Rio de Janeiro, is an area of fast urbanization, with a town planning project addressed to the upper middle classes, whereas most of the dwellers own one car. The area is geographically isolated from the remainder of the city by the ocean, by mountains, by forests, and by lagoons. Its occupation began in the early seventies, after the construction of a system of tunnels and viaducts coasting the sea. In order to organize the urban development of the area, Lucio Costa, the same town planner responsible for the project of Brasília, was called. A Master Plan of neighborhood occupation has taken place, influenced by the increasing use of private cars as a means of transport. The main highway design included a longitudinal road and a side road totaling six tracks in each direction and an avenue coasting the beach, with two tracks in each direction. The growth of the district has occurred in an accelerated manner, becoming the area in the city of Rio de Janeiro in which more buildings are built every year. The planned occupation has reserved housing areas for large condominiums and business areas in which magnificent shopping centers of several types, called consumption temples by many, have been systematically built. However, the explosive population growth, the general increase in the middle class income, the widespread access to automobiles, the attraction of the beaches, and the mentioned consumption temples for the residents of other parts of the city, are causing a progressive saturation of the highways, not only the internal ones but also the access roads, tunnels, and viaducts. These difficulties are discouraging long displacements for routine activities and encouraging the use of the above mentioned Neighborhood Shopping Centers.

For ABRASCE, Brazilian Association of Shopping Centers (ABRASCE, 2009), the definition of a Shopping Center requires six characteristics, as follows:

1) It consists of a set of planned stores, operating in an integrated way under one unique centralized administration;
2) It is composed of shops for exploring diversified or specialized branches of trade and services;
3) The tenant shopkeepers are subject to standardized contract rules, and, for most of the stores, such contracts state a variable rental clause according to the monthly revenue of the shopkeepers;
4) It has anchor stores, and special structural or marketing features, that operate as an attraction force to the Shopping Center in order to ensure the continuous influx of consumers essential for the proper performance of the venture;
5) It provides parking space consistent with the area of the shops and the corresponding influx of vehicles to the shopping center; and
6) It is under administrative control by individuals or groups of proven reputation and recognized entrepreneurship.
Types of Shopping Centers

In the popular understanding, there are many types of shopping centers, according to the type of shoppers or the type of merchandise sold. The terminology currently used includes: shopping center outlet, thematic shopping center, discount shopping center, wholesale shopping center, etc. However, in the present study, we prefer to adopt the proposal of the Urban Land Institute, ULI (1977), which takes into account the physical size of the premises and the population attracted to the shopping. According to the cited institution, shopping centers can be classified according to three patterns: Neighborhood, Community and Regional. Basically, the difference among them is linked to the type of anchor store, the physical area, and the diversification of the commercial project. Figure 1, complemented by Table 1, indicates the area of influence of each of those models. Figure 1 displays the influence upon the neighboring population, implies that a Regional Shopping Center reaches the resident population up to 25 km; a Community Shopping Center attracts the population up to 8 km, whereas the Neighborhood Shopping Center reaches the population up to 5 km away.

![Figure 1- Area of Influence of each type of shopping (Source: U.L.I., 1977)](image)

Table 1 complements Figure 1, specifying some of the general characteristics that each type of shopping center should have. Thus, for each type of shopping, Table 1 lists the type of anchor stores, the rentable gross area, including higher and lower limits, the minimum area of the land, and the necessary support population, which is an element of particular interest in this study. Certainly, for the largest shopping centers, a much larger support area is expected.

a) Neighborhood Shopping Center: More than 2/3 of the total Shopping Centers existing in the USA fall in this category. The attending population nears approximately 10,000 to 50,000 inhabitants. The revenue from shopping centers of this type is responsible for 75% to 90% of the total volume of sales in the USA. The displacement time of a typical customer is, at most, seven minutes by car, and the distance is no more than 5 km from the residence. The RGA (Rentable Gross Area) of a Neighborhood Shopping Center is about 3,000 m² to 10,000 m²;

b) Community Shopping Center: An enterprise in which the RGA is between 10,000 m² to 30,000 m², it attracts clients located up to 8 km away, and serves a population of 50,000 to 250,000 inhabitants. The anchor stores are usually a junior department store and a supermarket. This type of shopping center includes convenience goods, personal services, and food, with a large diversification of products and activities;

c) Regional Shopping Center: These constitute the most common type of shopping center in Brazil. Its RGA is between 30,000 to 100,000 m². The area of influence is around 15 to 25 km, and may reach more according the ease of access, the quality, and the amount of stores and anchor stores. The population served will be larger than 250,000 inhabitants. This type of shopping area is anchored by complete department stores, i.e., stores with a built area of approximately 9,000 m² that offer a variety of different products, such as clothes, furniture, utensils, etc.

The Shopping Center Industry In Brazil

The first shopping center built in Brazil was the luxurious Iguatemi, inaugurated in São Paulo in 1966. The expansion was intense and the numbers generated by the Shopping Centers’ industry, as shown in Table
2. based on the data of ABRASCE, show that this industry accounts today for 18% of the national sales, excluding the sales of automobiles.

Table 1. Shopping Centers’ classification

<table>
<thead>
<tr>
<th>Types of Shopping</th>
<th>Anchor Stores</th>
<th>Rentable Gross Area - RGA (m² x 10³)</th>
<th>Limits of RGA (m² x 10³)</th>
<th>Minimum area of the lands (m² x 10³)</th>
<th>Necessary population (10³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighborhood</td>
<td>Supermarket</td>
<td>5.0</td>
<td>3.0 to 10.0</td>
<td>12.0</td>
<td>10.0 to 50.0</td>
</tr>
<tr>
<td>Community</td>
<td>Variety and Department Stores</td>
<td>15.0</td>
<td>10.0 to 30.0</td>
<td>40.0</td>
<td>50.0 to 250.0</td>
</tr>
<tr>
<td>Regional</td>
<td>Complete department store (One or more)</td>
<td>40.0</td>
<td>30.0 to 100.0</td>
<td>120.0 to 200.0</td>
<td>More than 250.0</td>
</tr>
</tbody>
</table>


Location Methodologies

The main objective of this work is concerned with locating Neighborhood Shopping Centers. Next we introduce two competing methodologies for dealing with the proposed problem: the Voronoi diagrams and the p-median model. Although they involve radically different concepts, both methodologies share one feature in common, which is the minimum distance as a decision criterion.

Table 2. Shopping Centers Characteristics, Brazil 2009

| Number of Shopping Centers in Operation | 392 |
| Number of Shopping Centers under Construction | 19 |
| Rentable Gross area (millions m²) | 9,1 |
| Occupied area ( millions m²) | 20,4 |
| Places for cars | 672,000 |
| Satellite stores | 69,800 |
| Anchor stores | 2,792 |
| Cinema / Theater | 2,370 |
| Employment Levels (in thousands) | 757,000 |
| Revenue (in billions R$) | 79 |
| Sales in comparison to National Wholesale (Except Automotive sales) | 18.3% |

Source: ABRASCE. (2009).

Briefly, the Voronoi diagrams deal with the euclidean space, viewing the customers as situated anywhere on the space of interest from where they seek some desired service at the closest possible competing location. Such behavior appears reasonable in any urban setting in which the local residents look for a certain service at the closest available location. Therefore, given a set of facilities placed at fixed positions, these diagrams identify the areas of influence of each facility from which it would attract its clients. In the R², these attraction diagrams result in the form of polygons, as explained in Section 3.1 below.

The p-median model deals with the discrete space, in which the demands are concentrated in a given set of points, or centroids, that represent all customers within some stated vicinity, and the shortest distances are measured along arcs that connect the centroids. These customers are attracted by the closest facility that offers
the desired service. The p-median model might serve two complementary purposes: (i) it identifies the demand to be served by each fixed facility because the customers associated to each centroid are attracted to the closest facility; and (ii) the solution to the model answers the following location/allocation question: where to locate a given number of facilities such that the collective inconvenience is minimized.

The Voronoi Diagram

A Voronoi diagram is a special type of partitioning of a metric space determined by the distances to a specified discrete set of points in the space. This partitioning of the plane with \( n > 2 \) generating points results into convex polygons such that each polygon contains exactly one of these generating points and its interior points are closer to its generating point than to any other. Drawing on Boots and South (1997), the ordinary Voronoi diagram may be defined as follows: consider a set of \( n \) facilities, \( P = \{p_1, p_2, \ldots, p_n\} \), \( 2 \leq n \leq \infty \), in a two-dimensional space. Let the location of facility \( p_i \) be denoted by \( \mathbf{x}_i = (x_{i1}, x_{i2}) \). Let each facility be spatially distinct, i.e., \( \mathbf{x}_j \neq \mathbf{x}_j \) for \( j \neq l, \ j, l \in \{1,2,\ldots,n\} \). Let \( p \) be an arbitrary location in the plane indicated by \( \mathbf{x} = (x_1, x_2) \). Then the Euclidean distance between \( p \) and \( p_j \) is \( d(p, p_j) = \sqrt{(x_1 - x_{j1})^2 + (x_2 - x_{j2})^2} \). We call the region \( V(p_j) = \{x \mid \sqrt{(x_1 - x_{j1})^2 + (x_2 - x_{j2})^2} \leq \sqrt{(x_1 - x_{l1})^2 + (x_2 - x_{l2})^2} \} \) the ordinary Voronoi polygon of facility \( p_j \) and the set given by \( \Gamma(P) = \{V(p_1), \ldots, V(p_n)\} \) the ordinary Voronoi diagram of \( P \). Clearly, \( V(p_j) \) contains all locations that are closer to facility \( p_j \) than to any other facility.

Among the applications of the Voronoi diagram are the nearest neighbor queries, where one wants to find the facility that is closest to a given query point. Okabe and Suzuki (1997) make a conceptual overview of the idea and classify facilities into three types according to their relative size and form, in comparison with the area of a given region. If a facility is relatively very small, such as a food store in a city, the facility is called a point-like facility; if a facility is relatively long and very narrow, such as a railway, the facility is called a line-like facility; and if the area occupied by a facility is not negligible, such as the Central Park in Manhattan, the facility is called an area-like facility.

Boots and South (1997), examining the twin cities of Kitchener-Waterloo, in Canada, used these diagrams to delimit retail trade areas. They assert that in most of the models, the customers patronize one facility based on reducing their travel distances, but the authors enrich these models by assuming that customers might patronize more than one competing facility to obtain the desired products. In such cases, customers would look for the second closest retailer, the third closest, and so on. Considering these several possibilities, they consider the given positions of the competing retail stores and establish the polygons that correspond to the attraction areas of each retailer.

The P-Median Model

One of the most popular location model is the p-median model, which chooses \( p \) medians or locations in order to minimize the weighted sum of distances from the population centered in every vertex or centroid to its closest service location. These centroids concentrate the population that lives in a relatively small space, the census tracts, for example, as defined and collected by the National Census Bureau. The use of the p-median model is appropriate in cases in which each customer frequently travels the distance between his/her home and the place that offers the needed services. This is typically the case of the daily home-school-home travel of the student but also the eventual but successive displacement home-shopping-home for attending the daily needs. Assuming that all vertices or centroids can be elected as medians, the p-median model can be modelled as the following binary integer-programming problem:

\[
\begin{align*}
\text{Min } Z &= \sum_{i=1}^{n} \sum_{j=1}^{n} w_i d_{ij} x_{ij} \\
\text{Subject to } \sum_{j=1}^{n} x_{ij} &= 1; \quad i \in N
\end{align*}
\]
\[ \sum_{j=1}^{n} x_{jj} = p \]  (2)

\[ x_{ij} \leq x_{jj} : i, j \in N \]  (3)

\[ x_{ij} \in \{0,1\}; i, j \in N \]  (4)

where [\(d_{ij}\)] is the symmetric matrix of distances, with \(d_{ii} = 0, \forall i\);

[\(x_{ij}\)] is the allocation matrix, with \(x_{ij} = 1\) if vertex \(i\) is allocated to vertex \(j\), and \(x_{ij} = 0\) otherwise;

\(x_{jj} = 1\) if the vertex \(j\) is a median and \(x_{jj} = 0\), otherwise;

\(p\) is the number of service positions, or medians to be located;

\(N = \{1, ..., n\}\) is the set of vertices; and

\(w_i\) represents the weight of vertex \(i\).

The objective function indicates the minimization of the weighted distances between the customers’ population and the places that offer the service; the restriction (1) indicates that each vertex \(i\) is allocated to only one vertex \(j\); the restriction (2) establishes that only \(p\) vertices offer the proposed service; the restriction (3) says that the customer only goes to one vertex that must be a location that offers the service; and the restriction (4) imposes binary decisions.

A Case Study: Location Of Neighborhood Shopping Centers In Barra Da Tijuca – Rio De Janeiro, Brazil

Since the late seventies, Barra da Tijuca, a district of Rio de Janeiro, has shown an explosive population expansion, with an ever increasing annual number of licenses granted for constructing new housing units. In 2005, for instance, the district concentrated nearly 50% of the newly built apartments in the whole city. On the other hand, the district has approximately the form of a rectangle, and for a long time remained isolated from the rest of the town, because of its geographical topography. In fact, in the south there is the ocean; to the east and north there are the Tijuca Mountains and also some lagoons; and to the west an ecological reserve. The urban development of Barra da Tijuca began in the 60’s and complied with the Master Plan of Lucio Costa. The design included two longitudinal avenues, one close to the sea and another in its interior, along which most of the commercial centers and supermarkets have being located. The traditional small trade is restricted to two population streets that existed prior to the Plan, located at the doorway of the district on the east side, which at the time were only accessible by mountain roads. Figure 2 shows the map of the district as of the year 2001, with the lagoons and mountains to the north, the ocean to the south, and the ecological reserve to the east. The reader can notice about 12 black dots in the map; these indicate the location of 12 commercial centers of all types, but in fact, there are 31: one shopping specialized in automobiles, 7 regional shopping centers, and 23 other commercial centers, most of them currently, but improperly, denoted as shopping centers.

The Location Case Study

The location methodology parallels similar studies that apply the p-median model, such as those public facility applications mentioned before, according to the strategy of minimizing the average distance user-installation. The methodology considers each census tract, whose population is periodically counted during the National Census. These tracts are small geographical units defined by the Census Bureau responsible for the demographic statistics. Figure 3 portrays the census tracts used in the districts pertaining to the case study. For each census tract, the referred bureau makes public demographic and economic information such as the population, age groups and average income. Based on both maps and data, centroid or gravity center of each census tract is established, and the weighted network becomes available, according to standard procedures.

Due to the prevalence of condominiums composed of residential buildings and houses, some simplifications and adaptations are convenient for the purposes of the present study. Most often, one condominium has inside its limits several other census tracts, constituted by one or more residential buildings. The region encompassed by the case study also possesses extensive preserved land, large speculative areas awaiting development, and some areas of disordered occupation, most of them established before the Master Plan. Given those different nuclei, some simplifying hypotheses became reasonable, in order to reduce the
number of centroids considered in the study.

These simplifications were done in the following way:

a) For each census tract in the interior of a condominium, its center of gravity was identified;
b) The center of gravity of a group of centroids belonging to a large condominium was found through the simplified calculation:

\[
x_n = \sum \frac{w_i}{w} x_i \quad \text{and} \quad y_n = \sum \frac{w_i}{w} y_i,
\]

where \( i \) varies from 1 up to the number of tracts that are grouped, \( w_i \) is the population of each studied area, \( w = \sum w_i \) is the total population of all census tracts included in the larger census area, \( x_i, y_i \) are the Cartesian coordinates of the center of gravity of each area, and \( x_n, y_n \) the coordinates of the centroid of the collective census tracts;
c) In many cases small neighboring census tracts have also been consolidated into a single larger census tract, to form a new centroid, calculated in the same way as before, aggregating census tracts and all the residents in the areas;

Source: IBGE, National Census results, 2000

Figure 2: Map of the studied region with indication of the existing commercial centers

Figure 3. Census section generated by Estatcart
After these simplifications, the p-median model was applied. It is important to note that, according to the Census of the year 2000, there were 172 census tracts in the district, with a total population of 89,142 people. Given the simplifications described before, those 172 tracts were reduced to 51, as shown in Figure 4, together with their corresponding centroids marked by round spots and connected by arcs. On the one hand, about 94 tracts had large populations aggregated in a relatively small space composed of blocks of neighboring buildings, suggesting the reduction of these 94 to 16 tracts. On the other hand, among the other 71 tracts, 28 were internal to other tracts, due to the many condominiums, resulting in the incorporation of these internal sections into an enclosing tract. Thus, there was a drastic reduction in the problem size, without any major loss of precision.

Figure 4. Centroid location for each group of census tracts

In this way, with 51 vertices and 89,142 inhabitants, the purpose of the model was to find the best locations for installing Neighborhood Shopping Centers, to support the commercial demands of the population. Taking into account the recommendations of ULI (1977) that the population support to make possible a Neighborhood Shopping Center should be from 10,000 to 50,000, this study has assumed a value of about 15,000 people, resulting in the proposal of \( p = 6 \) shopping centers of the type for the studied area.

At this point we would apply the p-median model, but, given the typical limitations of Barra da Tijuca, a simpler heuristic methodology was chosen, which, in a certain way, recalls the diagrams of Voronoi. In the present case, we started from the east part of the district, which was at the origin of the occupation, and we tried to create connected areas, with about 15,000 inhabitants, but taking into account the local geographical restrictions, such as lagoons, bridges, restricted accesses, and so on. Advancing to the left and following the same procedure, the area was divided into six regions, as shown in Figure 5, in which the positions of the six proposed shopping centers are marked.

As a location study, the work could be considered complete at this point; however, because the objective was to propose a normative solution to seek public implementation, one more step was required to address two relevant items. The first was to verify the zoning for multi-commercial buildings and for commercial areas as defined by the Master Plan. On the other hand, it is important to notice that any shopping center is a generator of traffic, and its success is also linked to the ease or difficulty of customers’ entrance/exit. Thus, the location proposal should consider the street map and the flow of vehicles. Therefore, moving from the right to the left in Figure 5, the first shopping center should be located at a cross roads, and the four others along the main longitudinal road that crosses the district.

Figure 6 displays the main roads of traffic in the district, including the two longitudinal roads and the most important cross roads. Thus, the proposal is to locate the shopping centers on those main roads as long as the location is close to the main traffic flows. A final phase of this location study, which was not developed, has to involve the micro location, in which the costs of land as well as their availability near the selected points ought to be chosen, before the construction project is elaborated.
Implications of The Study

As discussed before, the area under study has 31 commercial centers of which, by their physical size and variety of products and services, seven ought to be considered Regional Shopping Centers, whereas other 23 may be seen as undefined types with mixed conceptions, most of them facing severe vacancy levels and frustration for the investors. In fact, the real estate boom in the area has impelled the construction of commercial centers of all types without any appropriate planning.

At present, the market forces appear to move in the direction indicated by the present study. Since the start of the recent international crisis in the year 2008, no more shopping center has been constructed or planned, and the crisis has induced several commercial centers in the region to lose their original shopping center characteristics by renting their spaces for administrative services, such as fitness academies, medical centers, and so on. Finally, although at the end of 2009 the financial crisis appears not to be so severe, no one doubts that the trend towards rationalization of the existing shopping centers will continue.

As a critical evaluation of the study, at least three statements might be derived: i) the proposal brought by the present work does not mean newer constructions, but a suggestion for a gradual and disciplined change of some commercial centers into Neighborhood Shopping Centers; ii) in the near future, the demographic growth, which is expected to remain intense, may justify a larger number of Neighborhood Shopping Centers; and iii) the use of a lower level of population support, for instance, 10,000 people rather than 15,000, still within the limits suggested by the ULI, would recommend nine rather than six Neighborhood Shopping Centers, which would mean the reshaping of virtually all existing commercial centers into a new project, with the best possible use of the existing premises.

CONCLUSIONS

The location of shopping centers seems to be an important issue that is rarely, if ever, addressed in the technical literature. There may be two reasons for this lack: one is that shopping centers are rarely planned to compose a network but are rather individual decisions about single ventures. On the other hand, by the same token, the technicalities involved in the decision process belong to the knowledge of consultants, which generally prefer not to openly share their findings and know-how.

This research has presented a brief overview of the development of the shopping industry from the early
times of trading up to the present magnificent shopping centers, or temples of consumption. A number of technical studies have been found that categorize the main types of shopping centers and evaluates the shoppers’ behavior. These studies have led to the concept of a Neighborhood Shopping Center, which satisfies the routine demand of the public living in its proximity.

The case study developed has considered a pleasant area in Rio de Janeiro that has recently been made more accessible by way of tunnels and roads coasting the ocean. The area is experiencing very fast population growth, with residents mostly from the upper social classes, who tend to rely on cars for their transportation. The resulting speculation and the perception of continuous opportunities for capital gains has caused an uncontrolled expansion in all types of construction, including housing, business, and shopping areas.

An obvious consequence is the increasing congestion in its highways and the public pressure for the future extension of the subway system to the area and its inclusion in the infrastructure plans for the 2016 Olympic Games. However, the present world crisis has shown a number of contradictions that might be attributed to the significant excess of commercial enterprises. Points (a) through (d) highlight some of the consequences of the excess of optimism and the general mistakes made:

a) Enterprises Overlap - a large number of enterprises overlap, suggesting a demand inferior to the one necessary to sustain the feasibility of the projects.

b) Lack of studies for the implementation of the enterprises. In their great majority, the installed shopping centers were not rented, i.e., the initial entrepreneur sold the units to a third party. For ABRASCE, nor either for ICSC (International Council of Shopping Centers), organ to which the first is affiliated, this sale no longer characterizes the enterprise as an actual shopping center.

c) The mistakes listed in items (a) and (b) above have resulted in vacancies in many enterprises. It might be noticed that, whereas the first installed shops are kept relatively well occupied, the ones that followed have several empty units. The existence of empty units led their owners, in order to reduce their losses, to lease such units to any activity, causing a vicious cycle where the failure in the desired mix of units to be leased carries a lower frequency of consumers, causing new empty units, and so forth. That cycle is eventually compensated by the enterprises in which the units are under the control of a group, which only opens concessions for leasing units considered strategic, and eventual losses in these units are compensated by leases of other stores.

d) Non-existence of new releases. Over the recent past, even preceding the international crisis, no new shopping areas in the district have been initiated, only the construction of residential buildings and commercial offices. Clearly, there is no justification for new construction of shopping centers in the district, suggesting a partial validation of the present study. In face of the certain economic loss, in order to compensate for their investments the owners who acquired units in those enterprises are hoping for the following events: i) other residential releases and commercial offices are established close to their enterprises; ii) that the accelerated population growth shall continue, in such a way as to create new flows of consumers; iii) that the new releases of commercial centers are built but supported by location studies ordered by their entrepreneurs or the public authorities observing the normative character proposed in the present study.

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REFERENCES


