THREE-STAGE LOCATION DECISION MODEL FOR A RETAIL POINT: A MULTICRITERIA AHP APPROACH

MODELO DE DECISÃO DE LOCALIZAÇÃO EM TRÊS ESTÁGIOS PARA UM PONTO DE VAREJO: UMA ABORDAGEM MULTICRITERIAL AHP

Paulo Rossi Croce¹
Lays de Matos Azevedo²
Henrique Rego Monteiro da Hora³
Alline Sardinha Cordeiro Morais⁴

Abstract: Coffee participates significantly on society's life, with its benefits and commercial importance, it is undoubtedly a precious commodity. Coffee shops are not different, it is an ideal place to relax, have a conversation or even do work related chores. This paper uses the Analytic Hierarchy Process to identify the best place to open a new coffee shop on a commercial center, since it is a complex problem that have to cover lots of alternatives, it was divided in three stages. First it is decided whether a store or a kiosk is better within this specific case, then decides the macro location and finally the specific spot. The analysis resulted on a store located afar from the food plaza, where have intense flow of clients passing by. It was possible to solve the doubts appointed at first by the decision-maker, besides it helps to improve the product quality, since the criteria was based thinking on the client's satisfaction.

Keywords: Coffee shop. MCDM. Vendor point. Entrepreneurship. Quality.

Resumo: O café participa significativamente da vida da sociedade, com seus benefícios e importância comercial, é sem dúvida um bem precioso. As cafeterias não são diferentes, é o local ideal para relaxar, conversar ou mesmo fazer tarefas relacionadas ao trabalho. Este artigo utiliza o Processo de hierarquia analítica para identificar o melhor local para abrir uma nova cafeteria em um centro comercial, uma vez que é um problema complexo que precisa abranger muitas alternativas, foi dividido em três etapas. Primeiro, é decidido se uma loja ou um quiosque é melhor nesse caso específico, depois decide a localização da macro e, finalmente, o local específico. A análise resultou em uma loja localizada longe da praça de alimentação, onde há intenso fluxo de clientes passando. Foi possível solucionar as dúvidas apontadas inicialmente pelo tomador de decisão, além de ajudar a melhorar a qualidade do produto, uma vez que o critério foi baseado na satisfação do cliente.

Palavras-chave: Cafeteria. MCDM. Ponto de venda. Empreendedorismo. Qualidade.

¹ Mestrando, Instituto Federal de Educação, Ciência e Tecnologia Fluminense, paulorossicroce@gmail.com
² Mestranda, Instituto Federal de Educação, Ciência e Tecnologia Fluminense, laysmaazevedo@gmail.com
³ Doutor, Instituto Federal de Educação, Ciência e Tecnologia Fluminense, henrique.dahora@iff.edu.br
⁴ Doutora, Instituto Federal de Educação, Ciência e Tecnologia Fluminense, amorais@iff.edu.br

Revista Mundi Engenharia, Tecnologia e Gestão. Paranaguá, PR, v.5, n.2, p. 214-01, 214-15, 2020
DOI: 10.21575/25254782rmetg2020vol5n21139
1 INTRODUCTION

Coffee is one of the most common and popular beverages of the world. Studies shows that this beverage improves the human brain functions (RUXTON, 2008). It is proven that coffee helps the mental health and increases the human lifetime (CRIPPA et al., 2014; FREEDMAN; HOLLENBECK, 2012; LUCAS, 2011). Besides, it is the most valuable commodity on the international market, the major crop in 2017 and 2018 increased the exportation resulting in 121.86 million bags, which was a record. South America took account of 47% of the world production, Asia and Oceania 29%, Central America and Mexico 13% and Africa 11%. Brazil is the world’s largest coffee producer, with the crops from April 2018 to March 2019 reaching 57.4 million bags (INTERNATIONAL COFFEE ORGANIZATION, 2018). The habit of coffee drinking became an important task of the modern daily routine (BAE et al., 2014).

Most coffee drinkers are more willing to spent more with a higher quality coffee. Coffee shops not only offer nourishment, but play a key role in social integration. An adequate location leads the business to success through the convenience and determinates potential clients that will be attracted to the store. Traditionally, the decision making of an establishment is taken by considering pasts experience, intuition or specialist’s opinion. However, intuition may not be the best decision since the judgment can be biased when it is influenced by the decision maker’s emotions or through first impressions.

The costs to take decision can be high and complicated considering the real state agencies, the local evaluation for buying or renting. In the other hand, there are scientific methods that helps the decision maker considering the costs and benefits, reducing the costs and the biased judgment considering the analyzed criteria.

With a good location, it is possible to deliver a better quality on the services. The studies about service quality has been explored since 1980 (ARAMBEWELA; HALL, 2006; PARASURAMAN; ZEITHAML; BERRY, 1985; RUIQI; ADRIAN, 2009). Coffee shops are very popular in around the cities, a place that people can chat, work and even have work related meetings.
kinds of places often have a cozy place to stay and relaxing music, stimulating and relaxing the clients. With a highly competitive market, there are many coffee shops across the city, and companies need to innovate or have a high-quality standard in order to attract potential customers and filiate them. An exceptional store mustn’t control only the operation costs, but also support the service quality according to the costumer’s needs (SAHU, 2006). With that thought in mind, this paper applies a multicriteria method to find a place of sale in a central commerce.

In a similar way, Ko and Chiu (2006) used multicriteria analysis to plan a location for a new coffee shop in Taiwan. The authors based on client’s satisfaction through an open questionnaire. Five students and ten managements with experience coffee shops that have at least 50 seats were invited to define the weights, objective and criteria.

Lee (2019) analyzed the attributes considered by a customer when going to a coffee shop through Analytic Hierarchy Process Technique. He defined and structured the factors regarding the goal, then implemented the survey phase and weighted the factors based on the survey results. The coffee shop selection attributes, which are: brand, product, service, interior and exterior, were extracted from previous studies.

Lo et al. (2005) stated that the restaurant’s owner must consider the importance of the ambient to be equal or even more important than the food itself. The authors distributed questionnaires to 725 students at K University and established marketing strategies for this campus specialty coffee shop through Importance-Performance Analysis (IPA) of service quality.

Even though there are studies that used multicriteria analysis to determine where to open a new coffee shop, no paper was found about opening one in a mall in Brazil. Since the country has the world’s largest coffee production and drinking coffee belongs to popular culture this paper will discuss which is better, to rent a store or a kiosk. Thereafter, point the best options to establish.
2 THEORETICAL FRAMEWORK

2.1 Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is used in this paper to assist on choosing a place to establish a coffee shop. According to Saaty (1977), the AHP method allows to choose the best choice of decision considering criteria, which can be quantitative or qualitative values. The process of AHP can be briefly described as the following steps: set up the hierarchy system by decomposing the problem into a hierarchy of interrelated elements; generate input data consisting pairwise comparation matrix in order to find the comparative weights among the attribute of the elements as part of the decision; synthesize the individual criteria, judge and determinate it relative weight; determine the aggregating relative weight of the decision elements to arrive at a group of ratings for the alternatives.

Considering \( C_1, C_2 \ldots, C_n \) as criteria and \( w_1, w_2 \ldots, w_n \) as weights, the \( w_i \) represents the importance level that \( C_i \) compared to \( C_i \)'s governing component as seen on Equation 1.

\[
A = \begin{bmatrix} C_1 & C_2 & \ldots & C_n \\ a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \ldots & a_{nn} \end{bmatrix}
\]

\[1\]

The values in matrix \( A \) are true only when they were assigned with an accurate sense of weight. That means the weight in question is true in a matrix when \( w_i \) is true weight of \( i \). The Equation 2 shows the pairwise comparison matrix \( A = [a_{ij}]_{n \times n} \).

\[
a_{ij} \approx \frac{w_i}{w_j} \quad \text{and} \quad w_i \approx a_{ij}w_j \quad i,j = 1, 2, \ldots, n
\]

\[2\]
The relative weight \( w_i \) may be estimate in this case by calculating the average of \( a_{ij} w_j \) as Equation 3 shows.

\[
\omega_{ij} \approx \frac{1}{n} \sum_{j=1}^{n} a_{ij} w_j \quad i, j = 1, 2, \ldots, n 
\]  

(3)

The weights can be estimated solving the eigenvector as Equation 4 shows, where \( n \) is the eigenvector of matrix \( A \) resulted from equation and \( n \) is related to the eigenvalue.

\[
Aw = nw 
\]  

(4)

The matrix \( A \) may not be consistent, so an estimation of \( w \) might satisfy the equation, as Equation 5 illustrates, where \( \lambda_{\text{max}} \) is the maximal eigenvalue.

\[
Aw = \lambda_{\text{max}} w 
\]  

(5)

To define the consistency of a matrix, when the maximal eigenvalue is equal to \( n \), the pairwise comparison matrix \( A \) is 100% consistent, since the chance to occur a perfect consistency is minimal, the consistency index (\( CI \)) is calculated to measure the consistency of the matrix \( A \), as seen on Equation 6.

\[
CI = (\lambda_{\text{max}} - n)/(n - 1) 
\]  

(6)

The consistency ratio (\( CR \)) is another indicator of consistency, obtained by the average random index (\( RI \)). The \( RI \) is a randomly generated reciprocal matrix with a scale from 1 to 9 with reciprocals forced. To be considered acceptable, a \( CR \) equals to 0.10 or less is needed.
**Table 1 - Pairwise comparation scale**

| Importance Intensity | Definition                          | Explanation                                                                 |
|----------------------|------------------------------------|----------------------------------------------------------------------------|
| 1                    | Equal importance                   | Two criteria contribute equally to the objective                          |
| 3                    | Weak importance of one over another| Experience and judgment slightly favor one criterion over another          |
| 5                    | Essential and strong importance    | Experience and judgment strongly favor one criterion over another          |
| 7                    | Very strong and demonstrated importance| A criterion is favored strongly over another, its dominance demonstrated in practice |
| 9                    | Absolute importance                | The evidence favoring one criterion over another is of the highest possible order |
| 2, 4, 6, 8           | Intermediate values between adjacent scale values | When compromise is needed                                                 |

**Source:** Saaty (1988)

**3 METHODOLOGY**

This paper was divided in three stages in order to achieve the goal, each problem will be solved using Analytic Hierarchy Process. All criteria and its weights were defined by three highly experienced marketing experts consulting the mall’s floor plan and renting prices. The Figure 1 shows the for planning a new coffee shop in a mall.
Stage 1 decides the kind of establishment to rent. The feasible options are store or kiosk. Stores have more available area, but costs significantly more than kiosks. The criteria settled in this stage were: Portfolio, it refers to the available products. It is tied to the area, meaning the more space available, more products can be commercialized; Price, overall costs of maintaining this kind of establishment, such as renting price and number of employees; Ambience, it associates with the environment around. Kiosks have limited space and are more difficult to customize.

After deciding which kind of installation, the next phase is reached. Stage 2 focus on which area is best to open a coffee shop. The criteria considering in this stage are: People Flow, the average number of people that passes on this area. According to the commercial center’s manager, the highest concentration of people happens on Fridays, Saturdays and Mondays from 5 pm to 6 pm, this average was obtained by counting how many individuals passes in each entrance between this peak time; Proximity to the food plaza, coffee has its unique smell as a marketing feat, food plazas has a variety of products and a mixed scent. So, if the coffee shop is too close to the food plaza, the smell of

**Figure 1** - Process for planning a new coffee shop.

Source: The Authors (2020)
coffee will be lost among the other food odors. The alternatives considered in this stage are the adjacent area near three entrances of the mall (labeled from A to C). The northwest area from the mall was not considered by the decision-maker, since there are others coffee shops in this range. The Figure 2 represents these designated places, the red square symbolizes an entrance, yellow, green and purple implies the Area A, Area B, Area C and Area D, respectively.

Figure 2 - Areas considered

Source: The Authors (2020)

The Stage 3 is the main goal of this paper, which is to choose the location to open a new coffee shop. The criteria applied in this phase by the marketing experts are the same as the Stage 3 but considering the place within the determined breadth.
4 RESULTS AND DISCUSSION

After analyzing the answers from the experts, an AHP was used to calculate the three selection problems, here separated in three stages as follows.

4.1 Stage 1

The relevant evaluation matrix to decide to rent a store vs kiosk is shown on Table 1.

| Portfolio | Price | Ambience | Weighted Value |
|-----------|-------|----------|----------------|
| Portfolio | 1     | 5        | 1              | 0.435          |
| Price     | 1/5   | 1        | 1/7            | 0.078          |
| Ambience  | 1     | 7        | 1              | 0.487          |

Source: The Authors (2020)

The available alternatives to determine the best installation for a coffee shop are compared according to the alternative’s weights attributed by the decision maker as shown on Table 2.

| Store | Price | Ambience | Alternative Priority Weight |
|-------|-------|----------|-----------------------------|
|       | 0.833 | 0.111    | 0.889                       | 0.964          |
| Kiosk | 0.167 | 0.889    | 0.111                       | 0.036          |

Source: The Authors (2020)

As result of the first stage, stores win with a large advantage of 96%. The criterion ambience has the most impact on the decision, since with a store there
is more ways to customize the place in order to attract more clients. The $CR$ and $CI$ was 1.65% and 0.96% respectively.

4.2 Stage 2

The next stage is to decide which zone of the mall is best for the new coffee shop. The Table 3 shows the evaluation matrix of the stage 2.

Table 3 - Evaluation matrix with respect to the goals of stage 2

|         | Price | Proximity | People Flow | Weighted Value |
|---------|-------|-----------|-------------|----------------|
| Price   | 1     | 1/3       | 1/7         | 0.093          |
| Proximity | 3     | 1         | 1/2         | 0.292          |
| People Flow | 7     | 2         | 1           | 0.615          |

Source: The Authors (2020)

The attributes are compared between themselves according to the Table 4.

Table 4 - Attributes of the goal of stage 2

|         | Price | Proximity | People Flow | Alternative Priority Weight |
|---------|-------|-----------|-------------|-----------------------------|
| 0.186   | 0.065 | 0.274     | 0.159       |
| 0.077   | 0.735 | 0.087     | 0.270       |
| 0.737   | 0.199 | 0.639     | 0.571       |

Source: The Authors (2020)

In this case, the Area C is preferred by 57%, since the criteria favors this place. There are two entrances and there is no food related establishment nearby, meaning that the smell of brewing coffee will prevail in the corridor. The $CR$ resulted in 0.42% and the $CI$ 0.25%.
4.3 Stage 3

At last, knowing that renting a store in the area C is the best option in this study, now the exact spot is evaluated on the Table 5.

|                      | Price | Proximity | People Flow | Weighted Value |
|----------------------|-------|-----------|-------------|----------------|
| Price                | 1     | 1/3       | 1/5         | 0.106          |
| Proximity            | 3     | 1         | 1/3         | 0.260          |
| People Flow          | 5     | 3         | 1           | 0.633          |

Source: The Authors (2020)

As the market experts confirmed, one of the main aspects to consider on food related commerce is its notoriety. With the marketing strategy, this can be a competitive advantage. So, for the purpose of choosing the store that meets these requirements, the last attributes in this study are presented on Table 6.

|                      | Price | Proximity | People Flow | Alternative Priority Weight |
|----------------------|-------|-----------|-------------|----------------------------|
| Store 1              | 0.109 | 0.761     | 0.071       | 0.217                      |
| Store 2              | 0.594 | 0.158     | 0.180       | 0.436                      |
| Store 3              | 0.297 | 0.082     | 0.748       | 0.347                      |

Source: The Authors (2020)

The Store 2 wins with a 43% of the preference among the others. The price of overall expenses of the Store 3 are high and the Store 1 has fewer passing clients than the others. As for the consistency indicators, CR resulted in 5.6% and the CI 3.25%.

So, the Figure 3 summarizes the entire process.
4.4 Discussion

From the results of the stages the criteria ambience and people flow. The attributes related to the place are important in this scenario, since the coffee shop is a place to be relaxed while enjoying a good beverage. In the other hand, Pettijohn et al. (1997) found that quality, hygiene and price are the three main attributes on fast food restaurants, while the ambience is not that important, but affirms that the customer satisfaction is close related to quality.

The performance score of the three stages were calculated through relative weights of each alternative in the performance criteria model. At a first glance, the food plaza instinctively looked the best option, since it is the place that customers look for food. The decision making tools helps to clear that clouded thoughts, in this study the best place to open a new coffee shop according to the method is not on the food plaza, but in a corridor near entrances. Ko and Chiu (2006) used six criteria to choose between a business,
school and hospital to open a new coffee shop in Taiwan and concluded that
the commercial center was the best alternative, followed by school and a
hospital.

Lee (2019) concluded through AHP analysis model that the most
important criterion according to Korean coffee drinkers is the coffee itself,
following by interior and exterior, brand and service. Just like this study, the
ambience is interpreted as the uniqueness and relaxing. The author noticed that
part of the costumers enjoys social networking, meaning that this particular
group pays more attention to drinks and snacks that can be photographed,
which means that the visualization is also very important.

5 CONCLUSIONS

This study used the AHP method to provide an assistance to open a
business in a commercial center. Decision-making for restaurants planning may
be a complex environment to achieve a good decision. Most of the times,
experts’ opinions are needed to accomplish acceptable and coherent results.

The problem described in this paper was divided in three stages to shrink
the number of criteria and alternatives, avoiding inconsistence. The first stage
resulted the alternative store with a ratio of 96%, considering the atmosphere of
the shop as the more important criterion. Then it was selected the Area C as the
place to look for a store, with a 57% rate. This place has two entrances nearby
and a supermarket with an intense people movement. Finally, the ultimate goal
is to determine the actual place of the shop. The store 2 is in the middle of a
large corridor and won by 43%.

With these results from the AHP method it is possible to say that it offers
a good solution for the decision-makers with a raking list, solving this selection
problem. However, there were limitations that future research could extend,
such as adding more criteria to increase the accuracy on solving this kind of
problem.
The Stage 3 is the main goal of this paper, which is to choose the location to open a new coffee shop. The criteria applied in this phase by the marketing experts are the same as the Stage 3 but considering the place within the determined breadth.

REFERENCES

ARAMBEWELA, R.; HALL, J. A comparative analysis of international education satisfaction using SERVQUAL. Journal of Services Research, v. 6, n. Special, p. 141–163, 2006.

BAE, J.-H. et al. Coffee and health. Integrative Medicine Research, v. 3, n. 4, p. 189–191, 2014.

CRIPPA, A. et al. Coffee consumption and mortality from all causes, cardiovascular disease, and cancer: a dose-response meta-analysis. American Journal of Epidemiology, v. 180, n. 8, p. 763–775, 2014.

FREEDMAN, N. D.; HOLLENBECK, A. R. Association of coffee drinking with total and cause-specific mortality. The New England Journal of Medicine, p. 14, 2012.

INTERNATIONAL COFFEE ORGANIZATION. World Coffee Production in Coffee Year 2017/18. [s.l.] ICO, 2018.

KO, W.-H.; CHIU, C. P. A new coffee shop location planning for customer satisfaction in Taiwan, International Journal of the Information Systems for Logistics and Management, v. 2, n. 1, p. 8, 2006.

LEE, C. A Comparative Study for Selection Attributes of Coffee Shop using AHP, International Journal of Innovative Technology and Exploring Engineering, v. 8, n. 8, p. 5, 2019.

LO, A.; TAN, A.; QU, H. Examination of selection criteria for customers visiting coffee houses: a case study of a coffee house chain in Hong Kong, I-CHRIE Annual Conference Proceedings, 2005.

LUCAS, M. Coffee, Caffeine, and Risk of Depression Among Women. Archives of Internal Medicine, v. 171, n. 17, p. 1571, 2011.

PARASURAMAN, A.; ZEITHAML, V. A.; BERRY, L. L. A conceptual model of service quality and its implications for future research. Journal of Marketing, v. 49, n. 4, p. 41–50, 1985.
PETTIJOHN, L. S.; PETTIJOHN, C. E.; LUKE, R. H. An evaluation of fast food restaurant satisfaction: determinants, competitive comparisons and impact on future patronage. *Journal of Restaurant & Foodservice Marketing*, v. 2, n. 3, p. 3–20, 1997.

RUIQI, Z.; ADRIAN, P. Using SERVQUAL to measure the service quality of travel agents in Guangzhou, South China. *Journal of Services Research*, v. 9, n. 1, 2009.

RUXTON, C. H. S. The impact of caffeine on mood, cognitive function, performance and hydration: a review of benefits and risks. *Nutrition Bulletin*, v. 33, n. 1, p. 15–25, 2008.

SAATY, T. L. A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology*, v. 15, n. 3, p. 234–281, 1977.

SAATY, T. L. *Multicriteria decision making: the analytic hierarchy process; planning, priority setting, resource allocation*. 2. ed., with new material added ed. New York: McGraw-Hill, 1988.

SAHU, A. K. Perceptions of Service Quality in an Academic Library: A Case Study. *Journal of Services Research*, v. 6, n. 1, 2006.