International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-9, Issue-7; July, 2022
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.97.32

Application of Analytical Hierarchy Process for site selection for container leasing and selling company

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Received: 22 Jun 2022,

Received in revised form: 15 Jul 2022,

Accepted: 21 July 2022,

Available online: 29 July 2022

***Keywords*— Multi-criteria decision making, AHP, Optimal location selection, Competitive advantage.**

***Abstract*—** *Obtaining a competitive advantage in the fierce globalized market has been the objective of several organizations. And, within this context, location can be identified as one of the important elements of differentiation. At the same time, the selection of an ideal location for setting up a company is a strategic challenge to be overcome by decision makers, and this is explained by the high number of attributes involved in this selection. Something that not only demands an expanded reflection on this topic, but also encompasses different opinions from different stakeholders that need to be brought together. Thus, considering the multiplicity of factors and sub-factors present in this context, in addition to the need to gather opinions, in this work a survey was used to support the operationalization of the Analytic Hierarchy Process (AHP) multi-criteria method, in order to contribute to the decision-making process. selection of a location for the installation of a container leasing and sales company. The results indicated that the main factor in decision making, according to the respondents, is regional development.*

I. INTRODUCTION

Facility location decisions are currently a critical element in strategic logistics planning for companies and regional development. The definition of this location impacts numerous operational, logistical and social decisions (Badri, 1999; Şahin, 2019). Most of the time, according to Heitz et al. (2019) the high costs associated with the acquisition of properties and construction of facilities make projects for the location or relocation of facilities a long-term investment.

But, although important, cost optimization is not the only preponderant element in decision making about the ideal location (He et al., 2018). For these authors, in addition to costs, it is necessary to understand and have knowledge of regional needs, forecasts and potentialities, something that can directly impact future operationalization.

Extending this perspective, Onstein et al. (2019) highlight that distribution structures are embedded in the spatial layout of the goods transport and storage system

used to move goods between the various places of production and consumption. According to Wang et al. (2020) this perspective should also observe the need for routing optimization, which will also be associated with the location of logistics, which, among other urban situations, will have collection and delivery with time windows – for example.

According to Faugère et al. (2020) "last mile" logistics, the final part of product delivery, is an essential but eminently expensive component of logistics in cities, being responsible for numerous annoyances in urban areas. These authors assert that the location of a facility in an urban environment must, among other functions, serve as a mobile access (hub), as flexible points of consolidation and transshipment, dynamically using the urban space.

Holl and Mariotti (2018) emphasize that the organization of modern economies is based on regional economic particularities and the available transport system, something that plays a growing role in the logistics sector to help overcome time and distance restrictions in modern times. urban supply chains. The view of this challenge is supported by Stević et al. (2018) defend the need to listen to different stakeholders and gather opinions as a way of expanding discussions and possibilities for solutions.

In addition, several researchers have highlighted the efficiency in the use of multicriteria methods to aid decision making and also as a way of grouping opinions (Ho & Ma, 2018; Santos et al., 2019; Sá et al., 2020; Ruiz Bargueño et al., 2021). Therefore, as in the operationalization of the process of selecting the ideal location, several attributes must be considered (Şahin, 2019) and, as a result, the involvement of different stakeholders, for the forwarding of possible solutions, an objective method is necessary in which all impressive factors are studied together and not randomly or subjectively (Sá et al., 2020; Ruiz Bargueño et al., 2021).

For these reasons, this work aimed to develop an approach to support the company´s location decision using the Analytic Hierarchy Process (AHP). This method was chosen because its application allows associating a real-world study with the decision to locate an installation, combining different opinions, in addition to allowing adaptations to different circumstances and scenarios. The general framework of analysis consists of a hierarchy of criteria that includes attributes related to traditional and logistical services and products.

II. URBAN MOBILITY AND LOCATION

Over the years, accelerated urbanization has led more than half of the world's population to live in cities, with 68% of the world's population expected to live in urban areas by 2050 (UN, 2019). Due to the proportions that this acceleration has demanded, it is crucial to understand land use, in addition to urban features such as infrastructure, facilities, population distribution, jobs and services, which play a fundamental role in health, urban livability and sustainability (Wojtyra et al., 2020).

On the other hand, Heitz et al. (2020) emphasize that it is essential to know the factors involved in the intended location, especially when the facility is to operate in an urban environment. These factors, according to Rodrigue (2020) depend on the nature of the activity for which the locational behavior is being investigated. Extending this view, for Zhang et al. (2020) this explains the highly diversified locational behavior of companies in the face of the global economy, considering, in addition to locational factors, the opinions of various actors that make up their ecosystem.

Different logistical solutions that are incorporated into consolidation plant and deconsolidation can help reduce negative impacts from urban cargo movements (Crainic et al., 2004; Browne et al., 2005; Tian et al., 2021). For this reason, according to Simoni et al. (2018) in recent years, several municipalities have promoted different measures to encourage the implementation of logistics centers in urban areas.

From another perspective, Lauermann (2018) understands that the increase in urbanization in large centers has directly influenced cities with lower status than the main city. This mega-urbanization, in addition to penetrating the soil of cities, also participates in the increase in the fulfillment of housing and infrastructure needs, becoming a determinant of the increasing lack of accessibility, change of land use and, in some cases, reaching the conversion of land. productive farms – complements this author.

Within this context, even with diversified academic advances, some theories on location have their origins attributed to the works of Weber (1929) - especially in his proposal to use a locational triangle to define the positioning and installation of facilities and, of Lösch (1954) who proposed a theory based on a central place and, based on that, considers a maximum number of points of spatial offer, implying an economic system dominated by a "primal city". Aldrich (1999), Gordon and McCann (2000) and Zhang and Guhathakurta (2021) when analyzing such works realized that, in general, location theory has as its main framework the hypothesis that every

enterprise determines its location in a way that can make as much profit as possible.

The contemporary market scenario, which imposes a global stance and scope on organizations, is highly competitive, and among other reasons, transversally, the choice of location must be preceded by a broad discussion and technical, literary and operational observation (Wojtyra et al., 2020; Tian et al., 2021). Based on this thought, a literature review was carried out to support the operationalization of the methodological approach of this work (Table 1).

Table 1: Influences on the location of facilities

Factor	Subfactors	Authors
Costs	Transport, land acquisition and maintenance	Guha and Khuller (1999), Snyder and Daskin (2005), Chen et al. (2014), Govindan et al. (2016), Temur (2016), Wang et al. (2016) and, Emeç and Akkaya (2018)
Demography	Demographic density and urban growth	Farahani et al. (2015), Esmaeilian et al. (2016), Ghadge et al. (2016), Temur (2016), Anvari and Turkay (2017), Ketokivi et al. (2017) and, Sakai et al. (2020)
Coverage	Proximity to suppliers, proximity to highways, proximity to customers and proximity to competitors	Guha and Khuller (1999), Jain et al. (2003), Snyder and Daskin (2005), Farahani et al. (2015), Govindan et al. (2016), Wang et al. (2016), Emeç and Akkaya (2018) and, Sakai et al. (2020)
Regional development	Land availability, skilled labor and industrial trend	Jain et al. (2003), Chen et al. (2014), Esmaeilian et al. (2016), Ghadge et al. (2016), Govindan et al. (2016), Wang et al. (2016) and, Anvari and Turkay (2017)
Government policies	Tax incentives and political stability	Guha and Khuller (1999), Snyder and Daskin (2005), Temur (2016), Anvari and Turkay (2017), Ketokivi et al. (2017), Emeç and Akkaya (2018) and, Sakai et al. (2020)

The selection of a facility's location is a multi-criteria problem, something that the literature supports in opinion, both in quantitative and qualitative terms (Table 1). On the other hand, there is also a consensus regarding conventional approaches to this type of problem, which tend to be less effective due to the complexity and the need to gather opinions in this selection (Rodrigue, 2020; Zhang et al., 2020).

Some authors such as Heitz et al. (2020), Sakai et al. (2020) and Zhang and Guhathakurta (2021) emphasize that at first glance, decisions about location appear to be applicable only to new ventures, something that must necessarily be rethought in the eyes of the contemporary and globalized market that is found.

III. ANALYTIC HIERARCHY PROCESS (AHP)

Daily decision making is something inherent to the commercial reality of organizations and, through this, even if unconsciously, the choice of alternatives that satisfy their needs is aimed. However, Şahin et al. (2019) note that, in various circumstances, this natural process has become complex and, for this reason, requires more time with analysis and judgment of the different ones that influence decisions. In such cases, there are methods that can support the decision-making process and gather opinions.

Traditionally, the literature highlights several studies on Multi-Criteria Decision Analysis (MCDA) that, in general, evaluate alternatives and indicate the most appropriate among different contradictory criteria (Ho & Ma, 2018; Santos et al., 2019; Sá et al., 2020; Ruiz Bargueño et al., 2021; Tuncel et al., 2021). According to Emeç and Akkaya (2018) the MCDA can be understood as instruments that help decision making and that seek the integration of objective measures through value judgment, allowing a broadening of the understanding of the problem and the prioritization of possible actions or alternatives.

In general, according to Şahin et al. (2019) and Ruiz Bargueño et al. (2021) multi-criteria methods are widely used in solving problems that aim to assist the decision-making process, as they provide diverse possibilities of choice. On the topic of location of facilities, for example, the work by Emeç and Akkaya (2018), used MCDA hybridly to propose a stochastic approach to multi-criteria decision-making to solve the problem of warehouse location, in an environment also with stochastic behavior that contained uncertain conditions. Similarly, Şahin et al. (2019) used the AHP as decision support for site selection to establish a new hospital, while Stević et al. (2018) used MCDA to analyze the location of a roundabout in an urban environment. The results of these researches suggest that the MCDA's, in addition to helping decision making, broaden the discussions around the problem studied, even

making it possible to gather opinions from different stakeholders.

In the opinion of Ho and Ma (2018), Santos et al. (2019) and Ruiz Bargueño et al. (2021), several multicriteria methods have been used in the literature, however, certain methods, due to their versatility, are used with high frequency, such as: Analytic Hierachy Process (AHP), Analytic Network Process (ANP), Elimination et Choix Traduisant la Realité (ELECTRE), Fuzzy Decision Approach (FDA), Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH), Preference Ranking Method for Enrichment Evaluation (PROMETHEE) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). As noted by these authors, multicriteria methods have been frequent in various problem areas and, over the last decade, several researchers have applied these methods in the field of production engineering (Santos et al., 2019; Ruiz Bargueño et al., 2021). For Ho and Ma (2018) all these methods are equally appropriate to assist in decision making under uncertainty, and each has its own advantages and disadvantages.

Corroborating this point, Badri (1999) and Emeç and Akkaya (2018) emphasize that the AHP, in addition to having as its operationalization principle, evaluate the nature of a problem, allowing different opinions of the actors involved to be considered. Furthermore, Thomas Lorie Saaty (Saaty, 1988) emphasizes that this method, considering a quali-quantitative approach in its design, has parameterizations that are adaptable to different conditions and situations. Also, for these reasons, in this work we chose to use the Analityc Hierarchy Process (AHP). This use is also based on the suitability of this method for unequal scenarios, in addition to being able to support decision-making that involve high complexity in relation to the multiplicity of criteria (Saaty, 1988; Şahin et al., 2019).

The AHP, due to the mixed use of quantitative and qualitative techniques, in addition to a structure in which the decision-making process is subdivided into hierarchical levels, allows for an expansion of reflections and, thus, favors decision-making (Sá et al., 2020). According to Saaty (1988), the method is based on three stages, namely: elaboration of a hierarchical structure, definition of priorities and verification of the logical consistency of judgments.

Thus, Sá et al. (2020) emphasize that in the first stage, the objective to be achieved, the attributes (factors and subfactors) related to the problem studied and the decision alternatives need to be organized in hierarchical levels (Figure 1). Subsequently, judgments are made based on the scale proposed by Saaty (1988) shown in Table 2.

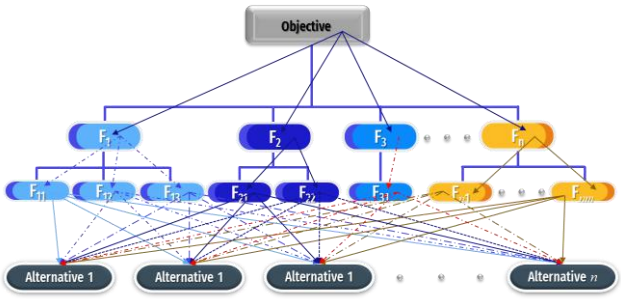

Fig. 1: Structure for operationalization of the AHP

Table 2: Numerical scale

Numerical scale	Verbal scale
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extremely important
2, 4, 6 and 8	Intermediate values
Increment 0.1	Intermediate values at the finest graduation of 0.1

According to Santos et al. (2019), regarding the operationalization of the congregation of opinions, the decision maker does not need to provide a numerical judgment; instead, it is recommended that a relative verbal analysis be carried out, ie, the comparisons of the different actors must be recorded in a positive reciprocal matrix *A* (Equation 1).

$$n(n-1)/2 \quad (1)$$

Where: *n* is the number of elements contained in matrix *A* (Saaty, 1988), defined as follows:

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{21}} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ \frac{1}{a_{n1}} & \frac{1}{a_{n2}} & \cdots & 1 \end{bmatrix}$$

Whereupon:

$$a_{ij} > 0 \rightarrow positive;\ a_{ij} = 1 \therefore a_{ji} = 1;\ a_{ij} = 1/a_{ji} \rightarrow reciprocal;$$

$$a_{ik} = a_{ij}.a_{jk} \rightarrow consistency$$

However, Ruiz Bargueño et al. (2021) show that the freedom provided by the method in defining attributes and

alternatives can promote the occurrence of inconsistencies in the evaluations. For this reason, Saaty (1988) proposed a maximum value of consistency for judgments to be considered coherent (Equation 2).

$$CR = {CI}/{RI} \quad (2)$$

To obtain the Consistency Ratio (*CR*) it is necessary to consider the Random consistency Index (*RI*), which consists of random judgments of 500 matrices of varying sizes, randomly filled (Şahin et al., 2019). Furthermore, Saaty (1988) also considers the Consistency Index (*CI*) that measures the coherence of judgments (Equation 3). This verification index has its use justification because the priorities of judgments only make sense if derived from consistent or quasi-consistent matrices are obtained. Saaty (1988) still emphasizes that the *CI* is related to the eigenvalue method.

$$CI = \frac{\lambda_{máx.} - n}{n-1} \quad (3)$$

Being $\lambda_{máx.}$ the maximum eigenvalue resulting from the splitting of the original matrix by the maximum eigenvector obtained after the normalization procedure of the comparison matrix and *n* is the number of criteria or sub-criteria calculated (Santos et al., 2019). Within this context, Saaty (1988) advocates that judgments will be considered reliable if they present a Consistency Ratio (*CR*) less than or equal to 0.10 ($CR \leq 0.10$). Thus, forward results of this value recommend the need to review judgments and/or previous phases of the AHP, however, if inconsistencies persist, it is necessary to carry out new judgments.

IV. METHODOLOGICAL APPROACH

This work presents an approach to the application of the Analytic Hierarchy Process (AHP) to identify attributes (factors and sub-factors) that were used in the indication of a location for the installation of a container rental and sale company in the northern region of the State of Espírito Santo (Brazil), which is considered a research unit. This choice was due to the representativeness and relevance that the region has within the local development scenario. Within this context, the population was defined as being entrepreneurs who have related businesses or that touch the research topic, in addition to companies, public institutions, municipalities and third-party organizations that also fit in. These are known through open databases, totaling a population of 857 potential respondents.

To help the analysis of statistical consistency, a confidence level (*Z*) of 90% was adopted, a maximum sampling error of 5% and a maximum percentage of 5 percentage points (Gonçalves, 2016). Thus, a minimum valid sample of 49 respondents was estimated. In addition, with the objective of contributing to the verification of the reliability of the data collected through the data collection instrument, the presence of missing values elements (missing data) and outliers (*Z* score with interval $|Z| < 3$, for a value of $\rho < 0,001$) were checked. If these elements occur, they would be removed from the sample due to the changes they may cause (Gonçalves, 2016). Cronbach's alpha ($C_\alpha \geq 0,7$) was used as a consistency checker of the data collection instrument (Khattak et al., 2019). To carry out these statistical analyses, the software SPSS 23.0 Trial version was used.

Thus, the methodological development took place in two complementary stages (Figure 2). The first stage of composition for the operationalization of the AHP initially made it possible to determine the delimitation of the problem and the proposed objectives, making it possible from this delimitation to visualize the breadth of the problem to be studied. After this procedure, the distinction and structuring of factors and sub-factors (attributes) and alternatives were made. Finally, in this first stage, opinions were judged in relation to these attributes and alternatives using the Saaty scale (Gonçalves, 2016).

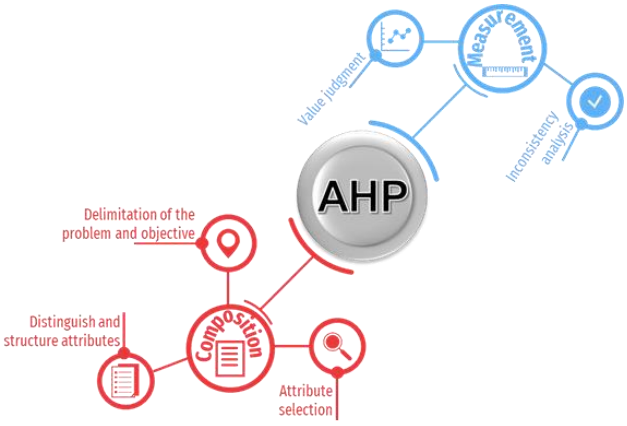

Fig. 2: Synthesis of the methodological approach

However, before starting the second stage, an opinion consultation was carried out with 7 experts with more than 10 years of professional experience, who work in the planning and regional development sector, industry management, city hall and government agency. This procedure contributed to elucidate the findings in the literature, as well as confirm these findings.

The second stage of the methodological development (measurement) consisted of applying a survey sent by email and social media to potential respondents, initially defined, for data collection, at which time value judgments were made for each attribute and alternatives.

Subsequently, the analysis of the inconsistency of these judgments was carried out, using the Expert Choice Trial software to support this operationalization.

V. RESULTS AND DISCUSSION

When verifying the proposed location problem, it was confirmed that in addition to the need for location, three municipalities were able to meet the needs and expectations expected by the respondents (Nova Venécia, Pedro Canário and São Mateus). Thus, in parallel with this discovery, a distinction and structuring of factors and subfactors (attributes) was initially performed (Table 3). After that, following the precepts of Gonçalves (2016), it was found by experts that these findings (attributes) and alternatives for the moment did not require additions and contributions. This concludes the first step proposed by the methodological approach (Figure 3).

Table 3: Attributes for checking the location of facilities

Factor	Subfactors
Costs (F_1)	Transport (F_{11}), land acquisition (F_{12}) and maintenance (F_{13})
Demography (F_2)	Demographic density (F_{21}) and urban growth (F_{22})
Coverage (F_3)	Proximity to suppliers (F_{31}), proximity to highways (F_{32}), proximity to customers (F_{33}) and proximity to competitors (F_{34})
Regional development (F_4)	Land availability (F_{41}), skilled labor (F_{42}) and industrial trend (F_{43})
Government policies (F_5)	Tax incentives (F_{51}) and political stability (F_{52})

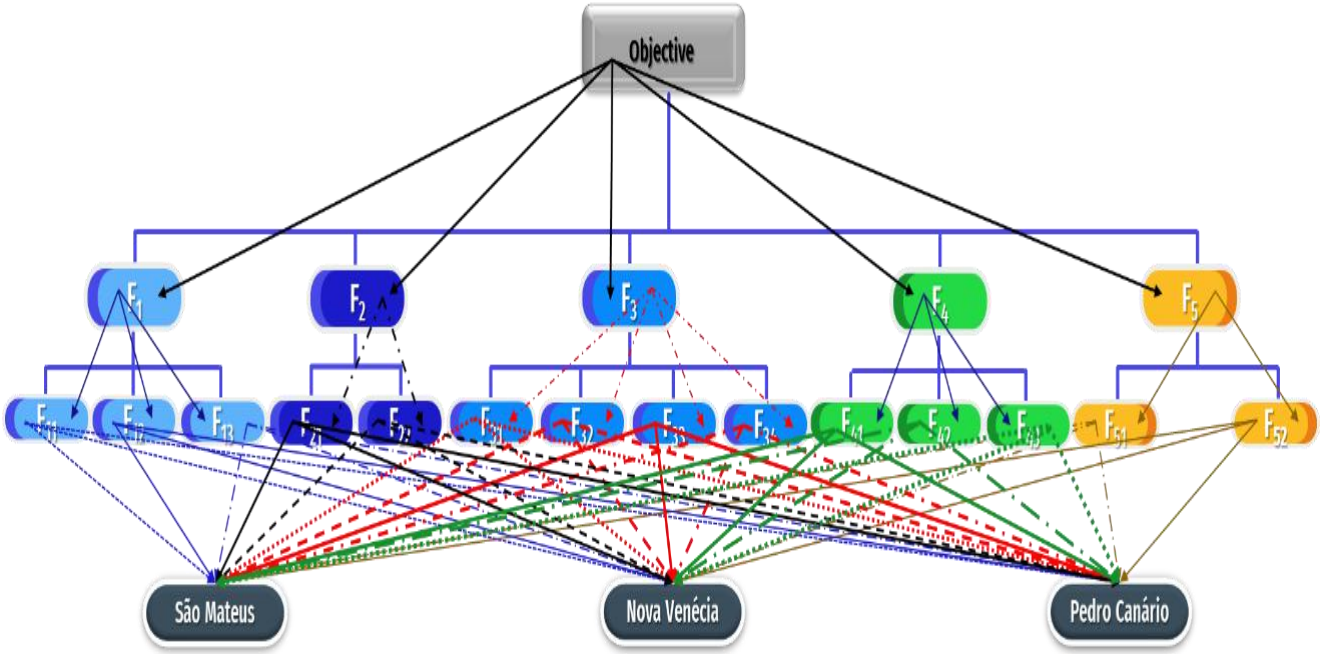

Fig. 3: Hierarchy for operationalizing the AHP

Based on the information obtained, a survey was carried out by e-mail and social media with potential respondents, considering a 5 year horizon for planning the installation, defined previously, and in this way equal weightings of the value of each attribute and alternatives considering the Saaty Scale (Table 2). The survey returned 459 answered forms, in this quantity there was the detection of 5 partially filled forms (missing values), which were removed from the sample. Proceeding with data mining and analysis, the presence of outliers 8 outliers were also verified, which, according to Gonçalves (2016) were also to be extracted. It is important to note that the calculated Cronbach's alpha (0.897) suggests adequate internal consistency of the data collection instrument used (Khattak et al., 2019). Thus, the final sample now has 446 valid forms, which is higher than the number initially calculated, thus confirming this sampling.

In this way, the second stage of the methodological development (measurement) consisted in the application of a survey sent by e-mail and social media with potential respondents, initially defined, for data collection, at which time value judgments were made. each attribute and alternatives (Gonçalves, 2016).

Continuing the analysis of the collected data, the hierarchical structure for the operationalization of the AHP (Figure 3) was modeled in the Expert Choice Trial software and, from that, the parity judgments were inserted. Based on this, the parity judgments of attributes (factors and subfactors) and alternatives were calculated (Table 4) observing their relationship and possible inconsistencies (Şahin et al., 2019).

Table 4: Synthesis of the operationalization of the AHP

Factor	Judgment	Inconsistency	Subfactors	Judgment	Inconsistency
F_1	0.122		F_{11}	0.661	0.04
			F_{12}	0.067	
			F_{13}	0.272	
F_2	0.041		F_{21}	0.200	0.00
			F_{22}	0.800	
F_3	0.272		F_{31}	0.253	
			F_{32}	0.131	0.04
		0.08	F_{33}	0.575	
			F_{34}	0.041	
F_4	0.499		F_{41}	0.117	
			F_{42}	0.200	0.01
			F_{43}	0.683	
F_5	0.066		F_{51}	0.833	0.00
			F_{52}	0.167	

In this way, the concern of the respondents with the economic situation of the place of implantation, as well as its perspectives and growth trend is observed. Something that is corroborated by He et al. (2018) who highlight that it is fundamental for the sustainable continuity of the business and the success of the organization to have regional support and possibilities.

On the other hand, Esmaeilian et al. (2016) point out that it is important to avoid errors (behavioral and non-behavioral) when selecting a location. The findings are in line with this premise, showing that they also consider a strategic location to be important, which allows for a wide coverage, both in terms of ease of access and in terms of the proximity of customers to their suppliers. This issue is so emphatic that Sakai et al. (2020) reiterate that behavioral errors often lead to hasty decisions, such as considering personal factors before the success of the location. The lack of know-how is also relevant to be considered, according to Wang et al. (2020) this absence, in most cases, generates a deficiency of analysis and appropriate investigative practice, disregarding critical factors and characteristics of the industry or business.

When analyzing each criterion, starting with Regional Development - F_4 (Figure 4), it can be seen that for the respondents, the industrial trend of the local potential over a five-year horizon is extremely relevant compared to the others, with almost 60% of weight, in addition to, there is also a need for the availability of skilled labor to carry out the activity. Confirming this perception, Zang et al. (2020) emphasize that the availability of specialized labor, with adequate education focused on the business and customers, experience and potential for the development of new skills, must be available, renewable.

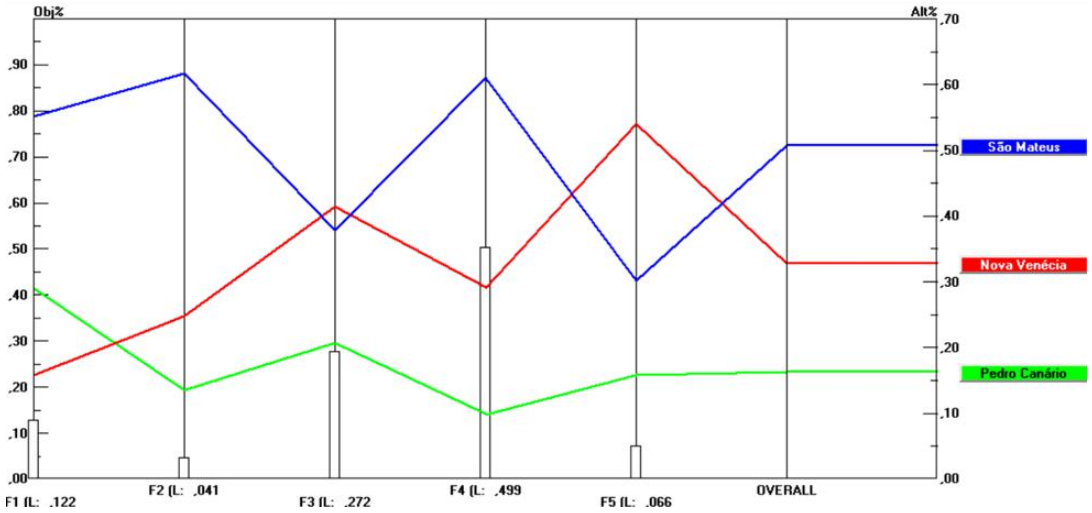

Fig. 4: Comparison of peer judgments

Thus, considering the F_4 attribute, São Mateus presented more adequate availability of land and land use, with an expectation of more expanded industrial development in relation to the other municipalities. On the other hand, when the Coverage factor (F_3) of the business was verified, the proximity of customers and suppliers was considered important (Table 4). In fact, for this reason Heitz et al. (2019), point out that in order to reduce costs, it is of great importance to be close to the consumer market and its suppliers, however, as the consolidation of this fact is almost impossible, the choice must be in accordance with the company's organizational strategy. From this point of view, the municipalities of São Mateus and Nova Venécia were evaluated as presenting more satisfactory conditions in two subfactors each, with the second municipality standing out with a small difference.

Analyzing Table 4, it is noticeable the high importance of considering transport costs in the location of a company, which according to Badri (1999) and Ketokivi et al. (2017) represent approximately 60% of logistics costs, something that still impacts between 5% and 26% of the company's gross revenue. It is worth noting that, in addition to transport costs, the respondents also consider maintenance costs to be important, with São Mateus standing out in both subfactors.

The results also reveal that the factor related to government policies (F_5) was not considered of solely decisive importance (Table 4), however, both states and municipalities are, in most cases, offering different types of benefits, according to Anvari and Turkay (2017) and, from there, seeking to attract new facilities to their regions, something that according to these authors can make a competitive difference when it comes exclusively to costs.

Another important result is related to tax incentives (F_{51}) which, in the opinion of the respondents, are the main benefit in the search for the right place. Within this context, the judgments point to Nova Venécia as the most attractive place. It is worth noting that this municipality has Law No. 3014 of March 2010, which provides for the granting of tax incentives and economic incentives for new ventures to be installed in the municipality. The São Mateus Chamber also approved a Bill (040/2014) in August 2014, which creates tax incentives with the aim of attracting new companies. Something that, Rodrigue (2020) reports that it is necessary in terms of attractiveness, that a municipal area reserved for new ventures, has the forecast of exemption or incentive in the reduction of taxes. For this author, this is an important factor to be considered in a facility installation, due to the fact that taxes affect the final result in some financial statements.

On the other hand, the subfactors related to Demography (F_2) were considered to have less influence on the location selection, with urban growth highlighted (F_{22}). This growth, according to Simoni et al. (2018) is an important phenomenon to be understood and monitored throughout, and should even serve as a point of reflection regarding the location of an enterprise. In factor F_2, the municipality of São Mateus prevailed.

Finally, a sensitivity analysis was performed to analyze the effect of changing the weights of the main factors in the ranking of municipalities. Differences in the classification of municipalities were not significant using three scenarios, as indicated by Gonçalves (2016). However, it is worth mentioning that with a change of 87.5%, the ranking is slightly altered, demonstrating that the judgments are consistent with the choice of the municipality of São Mateus for the new facilities of the company for leasing and selling containers.

VI. FINAL CONSIDERATIONS

The location of facilities has a high potential for sustainable regional development, promoting several benefits, such as diversifying the economic matrix, contributing to increase national and regional economic growth, as well as increasing employment opportunities. Thus, according to the findings of this work, which corroborate the literature, it is abundantly important to prioritize viable locations for facilities installations, as it is a multifaceted decision process.

In this way, taking into account the fact that there is no method, tool, approach or a comprehensive decision support structure for the selection of any location for facility installation, which cannot advance and indicate other points of view, this work tried to address this research gap. For this reason, it proposed a methodological approach that can be adapted, readjusted and improved for the selection of locations for the installation of companies.

Thus, according to the opinions of different stakeholders working in the researched sector, the main determinant attributes for the location of container rental and sale companies were identified, also using expert feedback, determined through the use of the multicriteria Analytic Hierarchy Process method. (AHP). In general, after using the different opinions and perceptual judgments regarding the decision alternatives gathered through the AHP, the following factors and sub-factors emerged as essential: regional development (regional trend and skilled labor); scope (closeness to customers and proximity to suppliers) and costs (transport and maintenance). The results revealed the municipality of São Mateus as the most ideal place for the installation of container rental and sale companies.

Within this context, it is important to emphasize that decisions to choose the location for the installation of companies are taken as a result of strategic management priorities, and should provide a sustainable competitive advantage over its competitors. We hope that research using the AHP will continue to be an important component of public and business management, policy and, above all, operational research. The results of this work can be useful for regional development policy makers, private economists and public and private investment decision makers to choose the most appropriate locations.

We use a limited number of attributes (factors and subfactors) and potential alternatives in this work. Some of these potentially significant attributes (land ownership, geographic information systems, etc.) that influence site selection for business installations were not included in the analysis. As an example, the cost of land is one of the important factors in this process. However, in this study we evaluated the northern region of the State of Espírito Santo (Brazil) and did not cover specific locations within the areas that make up this region. Other limitations of the work were the omission of data and information from public agencies. Therefore, the results of this work cannot be generalized.

In future research, we recommend analyzing the adjustment of other approaches and methods to the problem of site selection for the installation of container rental and sale companies, such as the hybrid use with fuzzy logic, Structural Equation Modeling (SEM), Data Envelopment Analysis (DEA), among other resources. In choosing and weighting the attributes, it would be abundantly useful to assess the opinions of academics, in addition to the expanded diversity of specialists and stakeholders. This, if necessary, because the AHP has a dependency in terms of external validity.

ACKNOWLEDGEMENTS

We thank the Operations Research Laboratory, Logistics and Transport (POLT) of the Federal University of Espírito Santo (UFES)/ University Center North of the Espírito Santo (CEUNES) by the academic and technical support in the design and development of this work.

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