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Multicriteria Approach to Indicators of a Humanitarian Logistics Operation

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Abstract

Operation Acolhida lingers due to the need for logistical and humanitarian aid to Venezuelan immigrants and refugees, providing dignity to vulnerable people who face deep economic and financial crisis in their homeland. After more than five years of operation, several indicators were consolidated, comprising a list of important information for decision making. The demand for prompt intervention with quick and effective responses requires the use of reliable indicators. This article integrates the AHP-Gaussian method with SMART criteria to evaluate the operation's indicators so to put them in order, handing over effective and reliable data for decision making. In the final evaluation, it was possible to verify that the integration of the AHP-Gaussian method with the SMART criteria produced satisfactory results for ordering the indicators and suppressed the decision maker's evaluation, resulting in long-lasting outcomes.

Keywords: AHP-Gaussian. SMART. Indicators.

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1. Introduction

Unfortunately, humanitarian action is not an exact science and will depend on the humanitarian worker's ability to adapt to situations on the ground [1].

Within the global humanitarian actions, today and in Brazil, we have Operation Acolhida, created through Provisional Presidential Decree No. 820, of February 15, 2018, and Decree No. 9,825, of February 15, 2018. Such documents acknowledged the disordered and unpredictable population increase that took place in the Brazilian state of Roraima as a result of the migratory flow of people resulting from the humanitarian crisis in the Bolivarian Republic of Venezuela towards Brazil.

With the intensification of the economic crisis in Venezuela, which has led to food shortages as well as a lack of basic products in the country, hundreds of Venezuelans began to cross the Brazilian border in search of food, health care, subsistence products, and opportunities for work. This flow began to increase from 2016 onward and had major impacts on public services in the Brazilian state of Roraima, mainly in the cities of Pacaraima and Boa Vista, and later in Manaus, Santarém, and Belém. The greater number of immigrants increased the local demand for social assistance, health, and safety, changing the routine of cities and their populations [2].

Thus, in February 2018, the Federal Emergency Assistance Committee was established, and the Humanitarian Logistics Task Force [3] was created to work on border planning, reception, shelter, and interiorization of Venezuelan immigrants.

The Humanitarian Logistics Task Force was created with the Brazilian Armed Forces as a component, responsible for organizing and structuring the operation.

The Brazilian Armed Forces provide humanitarian aid to immigrants from Venezuela with the purpose of mitigating the situation of vulnerability and preventing it from evolving into a humanitarian crisis in the country.

The structure and system of the operation are known and suffer demands with variability, whether due to an increase or reduction in the flow of migrants, changes in contingents, alteration of contracts, or other aspects that impact the established system. For decision-making, the Humanitarian Logistics Task Force relies on several indicators produced by the operation cells: sections, fractions, and specialized detachments in each area of activity. The indicators produced are centralized in an operations center, where periodic meetings take place.

Due to the large number of indicators, the information produced causes difficulty in interpreting and using it for decisions, requiring an evaluation of each indicator, which characterizes their importance with criteria measured by specialists and ordered in a global preference.

For the evaluation of the indicators, Multicriteria Decision Support (AMD) was used, which consists of a set of techniques to help a decision-maker [4].

Of the different methodologies developed with the purpose of supporting problems involving multicriteria decisions [5], the AHP method demonstrated potential for the evaluation and ordering of the operation indicators.

Saaty [6], creator of the AHP method in the late 1970s, mentions that it seems inevitable that there will be a need for an organized way to make decisions and collect relevant information. For him, a group must decide by exposing all the important factors and negotiating their understanding, beliefs, and values.

But a peculiarity of the operation, the exchange of quotas that currently occurs every 5 months, attributed the need to have an evaluation that is not based on the opinion of the decision maker, so that the ordering is more perennial with a durability of more than 5 months.

Thus, the AHP-Gaussian Method (Process of Analytic Hierarchy-Gaussian) — published by Santos, Gomes, and Costa [7] in the International Journal of the Analytic Hierarchy Process (IJAHP) — gives a new approach to the original AHP, removing the evaluation dependence between the decision maker's criteria and using the averaging, the standard deviation, and the Gaussian factor as parameters for obtaining priority in the alternatives.

For the evaluation of key indicators, Doran [8] presented five important parameters that became known as SMART criteria: specific, measurable, assignable, realistic, and time-related.

This article aims to use the AHP-Gaussian method based on SMART criteria to order the main indicators of a humanitarian logistics operation for decision-making.

2. Theoretical Reference

2.1. Operation Acolhida

Operation Acolhida was created to restrain or minimize the negative consequences of the disordered and unpredictable population increase that occurred in Brazil, more specifically in the State of Roraima, directly impacting essential public services, as a result of the migratory flow caused by the humanitarian crisis in the Bolivarian Republic of Venezuela [9].

It should be noted that there is a high degree of originality, with few doctrinal references that address this topic in depth. In this context, all the logistical and operational plans that the Task Force Command has produced are of great value for future operations that may occur in an interagency environment, particularly in the event of humanitarian crises.

The main objective of Operation Acolhida is to guarantee humanitarian assistance to Venezuelan refugees and immigrants in Roraima by offering emergency assistance, seeking to organize the border, controlling the migratory flow, and providing assistance to immigrants.

It is a joint, interagency, logistical, and humanitarian operation. Its mission is to cooperate with the federal, state, and local governments in emergency assistance measures for the reception of immigrants from Venezuela in a situation of vulnerability due to the migratory flow caused by the humanitarian crisis.

Several measurements have been made since the creation of the operation, forming indicators that are used in decision-making, data that is compiled, and efficiency targets that have been established. The indicators permeate the sections of the operation and the command, but there is still no order for them and no study that measures the quality and importance of the indicators available in the operation.

2.2. Key Performance Indicators

Indicators are measures that contribute to the management of the operation; they contribute to the achievement of objectives and targets and are important factors for decision-making.

From its inception to the present day, the following indicators have been developed and controlled:

- Average daily arrival of immigrants
- Monthly average of internalization
- Number of sheltered beneficiaries
- Shelter occupancy rate
- Shelter capacity
- Daily number of health care visits
- Number of spontaneous occupations
- Daily average of attendance at the Identification and Sorting Station
- Occurrences involving immigrants
- Number of homeless people
- Vacancies available in shelters.

To evaluate the indicators of Operation Acolhida, it is necessary to establish criteria so that they can be measured by specialists.

2.3. SMART Criteria

The acronym SMART was first introduced by Doran in 1981 [10], and it refers to five standard criteria for evaluating key performance indicators: specificity, measurability, feasibility, relevance, and timeliness.

The use of SMART criteria for evaluating key performance indicators is widely accepted [11], and for an indicator to have quality and be useful for management, it needs a high degree of satisfaction for each SMART criterion.

The evaluation of each criterion should consider the objectives, strategies, and visions of the operation in order to build a portfolio of management improvement, enabling an information structure that can anticipate responses and decision-making, minimizing negative effects.

The article considered the SMART criteria for analyzing the indicators present in the operation, considering the study by Selvik [11] that replaces the measurability criterion with manageability and applies the following concepts to each criterion:

- **Specificity**: precision; the indicator must be clear; and the numbers must not depend on who is producing them or who is interpreting them.
- **Manageability**: deals with the ability to control the level of reliability based on the information obtained.
- **Assignability**: also known as reachability, the indicator must be realistic, achievable, and provide adequate information regarding the achievement of the objective.
- **Realistic**: the indicator must be important for the performance of the operation; it must provide essential information for the improvement of the operation.
- **Time-related:** It should cover an appropriate, predefined, and relevant period.

With the evaluation criteria defined, a multi-criteria decision method was sought to obtain an ordering of the key indicators.

2.4. AHP-Gaussian method

It was at the Wharton School at the University of Pennsylvania that Thomas Saaty developed the Analytic Hierarchy Process (AHP) method in 1970.

The main objective of the AHP method is to help make complex decisions based on mathematical and psychological concepts. Considered an input method of multi-criteria decision-making (MCDM), it is the most widely used method in the world [12]. Its importance is related to the ability to measure and synthesize the multiplicity of factors in a hierarchy [13].

In order to better understand the problem, Saaty proposed to decompose it into a hierarchical structure in order to allow the independent analysis of its elements, both in quantitative and qualitative aspects, comparing the elements in pairs.

For Saaty [6], it seems inevitable that we need an organized way to make decisions and collect information relevant to them when a group must decide by exposing all the important factors and negotiating their understanding, beliefs, and values.The AHP method is considered a systematic approach to complex problems capable of structuring experience and intuition in a decision based on heuristics, with a well-defined methodology and solid mathematical principles [14], allowing the insertion of qualitative criteria [13] as the opinions of experts and decision-makers.

Aiming to propose a new approach to the AHP method, Santos et al. [7] published an article in the International Journal of the Analytic Hierarchy Process (IJAHP), proposing the use of the mean and standard deviation to order the alternatives rather than the dependence on the matrix of evaluation between criteria, as foreseen in the original AHP method. The new approach, called AHP-Gaussian, simplified some steps of the original method, eliminated the decision maker's evaluation (peer-to-peer evaluation), and obtained excellent results.

Santos et al. [7] suggested the application of the model in the military area, at the tactical, operational, and strategic levels, in order to solve alternative ordering problems and facilitate decision-making.

The AHP-Gaussian was chosen because the decision maker does not carry out a peer-to-peer comparison since Operation Acolhida has a human resources structure that is replaced every 5 months, with contingents of military personnel periodically changing.

Within the need to obtain perennial key indicators for the operation, it is important to eliminate the subjectivity that a decision-maker may have due to their periodic replacement.

The proposed model uses only the evaluation values of the specialists: seven one-year nominated servicemen who assigned a value from zero to seven for each criterion of each indicator.

The AHP-Gaussian allows qualitative attributes to be converted into quantitative attributes, belonging to compensatory methods and independent attributes.

3. Model for Ordering the Indicators

The integration of the AHP method with SMART criteria was used for the first time by Shain and Mahbod [16]. The authors' intention was to build a portfolio of well-made key indicators that were aligned and capable of meeting the objectives of the company or organization, thus leading a process of prioritizing.

For the present article, the model used by Shain and Mahbod was suitable for a humanitarian logistical operation and considered further studies of this integration by Kaganski and Toompalu [17], Gozaçan and Lafci [10], Vosoughi et al. [18], and Selvik et al. [11].

For Selvik et al. [11], the assessment of the quality of key indicators is largely performed using the five criteria referred to in the literature as SMART.

It is important to highlight that Operation Acolhida, throughout its seasoning process, produced various data and information. Based on experience, much of the data and information was transformed into performance indicators.

Uchoa [19] describes the indicator as a critical variable that needs to be controlled and maintained at certain levels.

The model proposed by Shain and Mahbod [16] was adapted using the AHP-Gaussian to meet the peculiarity of decision-maker turnover. Thus, the model for ordering the indicators uses the integration of the AHP-Gaussian method with SMART criteria, using existing indicators in Operation Acolhida.

The AHP-Gaussian is used as a multicriteria decision-making tool, with the criteria defined in the acronym SMART updated by Selvik [11], including specificity, manageability, achievability, relevancy, and time-based criteria.

The AHP-Gaussian structure foresees a hierarchy with the main objective at the top, the SMART criteria at an intermediate level, and the alternatives — that is, the existing indicators in the operation — at the lowest level of the hierarchy.

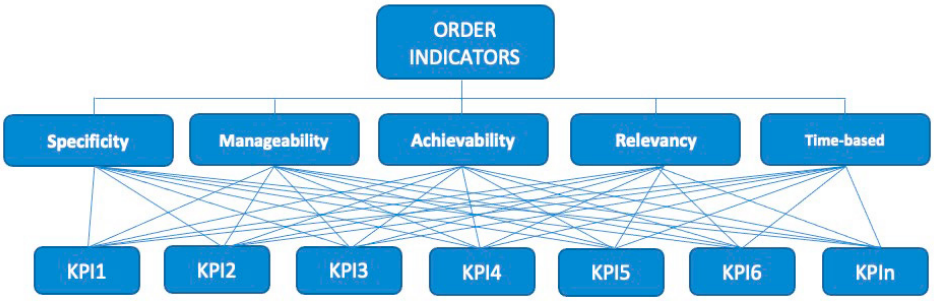

Fig. 1. Hierarchy structure.

That way, it is possible to associate the strategic objectives of Operation Acolhida to the ordering of the performance indicators.

The AHP-Gaussian/SMART method has the advantage of considering both qualitative and quantitative factors [10] as well as the possibility of eliminating the decision maker's peer evaluation, turning the indicators into long-lasting data for this application.

The AHP-Gaussian method has the following axiomatic structure:

- **Definition of the Set of Criteria and Alternatives**

Construction of the evaluation matrix composed of the set of alternatives and criteria under evaluation.

- **Evaluation of the Criteria**

Attribution of judgments of importance between the criteria, consistency test of the contributions, and algebraic procedures to obtain the priority vector and weight of the criteria. The objective of this phase is to determine the priorities of the criteria.

- **Evaluation of Alternatives for Each Criterion**

Attribution of judgments of importance between the alternatives in each criterion, attribution consistency test, and algebraic procedures to obtain the priority vector for each alternative in each criterion. The objective of this step is to obtain the local priorities of the alternatives for each criterion.

- **Preference Aggregation Process**

Weighting of the priority vectors of the alternatives by the weights of the respective criteria and the sum of the priorities. The objective of this stage is to determine the global priorities of the alternatives to the problem. The final priority is global preference.

The viability of the AHP-Gaussian model is only satisfied in scenarios in which the alternatives have cardinal entries in the analysis criteria, such as in the case of the evaluation made by the specialists, who assigned values from 0 to 7 for each indicator in each criterion.

4. Application of the model

4.1. Evaluation of Experts by Criterion

The indicators were evaluated using the consensus of a team of specialists who evaluated each SMART criterion using a scale from 0 to 7, with the index 7 corresponding to the maximum evaluation of the indicator in relation to a given criterion and the main objectives of the operation.

The specialists are seven officers who make up the Task Force in critical leadership roles, selected in a selection process conducted by the Army General Staff with proven experience and assigned for a period longer than the contingent.

From a meeting with the specialists, through a discrete evaluation at 7 levels, the AHP-Gaussian tool in VBA (v.1) was used, developed by Baldini et al. [20] and supported in Excel software.

4.2. Determining the Decision Matrix

Tipo	MAX	MAX	MAX	MAX	MAX
	C1	C2	C3	C4	C5
A1	7	1	1	3	7
A2	7	4	5	7	7
A3	7	2	5	7	7
A4	7	2	3	3	7
A5	7	2	3	7	7
A6	7	3	5	4	4
A7	5	2	2	5	7
A8	7	7	4	7	7
A9	4	1	4	2	1
A10	2	2	3	7	7
A11	5	2	3	7	7

Fig. 2. decision matrix [20].

4.3. Mean, Standard Deviation and Gaussian Factor

In this step, the standard deviation of the criteria, the average of alternatives, and the calculation of the Gaussian factor for each criterion were made, along with the normalization of the Gaussian factor.

Média	0,09090909	0,09090909	0,09090909	0,09090909	0,09090909
Desvio Padrão	0,02615796	0,06053258	0,03403525	0,03412865	0,02852955
Fator Gaussiano	0,28773755	0,66585835	0,37438777	0,37541512	0,31382505

Fator G. Norma.	0,14264037	0,3300865	0,18559555	0,18610484	0,15557274

Fig. 3. Mean, Standard Deviation and Gaussian Factor [20].

The higher the value of the Gaussian factor, the more difficult it is to obtain a high score on the criterion [21].

4.4. Weighting of the Decision Matrix and Ordering (Global Preference)

Fig. 4. Weighting and Ordering [20].

	C1	C2	C3	C4	C5	AHP-G	RANK
A1	0,10769231	0,03571429	0,02631579	0,05084746	0,10294118	0,05751197	10
A2	0,10769231	0,14285714	0,13157895	0,11864407	0,10294118	0,12503203	2
A3	0,10769231	0,07142857	0,13157895	0,11864407	0,10294118	0,10145442	3
A4	0,10769231	0,07142857	0,07894737	0,05084746	0,10294118	0,07906896	8
A5	0,10769231	0,07142857	0,07894737	0,11864407	0,10294118	0,09168623	5
A6	0,10769231	0,10714286	0,13157895	0,06779661	0,05882353	0,09691676	4
A7	0,07692308	0,07142857	0,05263158	0,08474576	0,10294118	0,07610457	9
A8	0,10769231	0,25	0,10526316	0,11864407	0,10294118	0,15551435	1
A9	0,06153846	0,03571429	0,10526316	0,03389831	0,01470588	0,04869952	11
A10	0,03076923	0,07142857	0,07894737	0,11864407	0,10294118	0,0807139	7
A11	0,07692308	0,07142857	0,07894737	0,11864407	0,10294118	0,0872973	6

5. Results Analysis

The use of the AHP-Gaussian method with SMART criteria made it possible to order the indicators of Operation Acolhida considering the objectives of the operation, the first 3 indicators being:

- Daily average of attendance at the Identification and Sorting Station
- Monthly average of internalization
- Number of sheltered beneficiaries

The use of the mean, standard deviation, and Gaussian factor allowed the application of the Saaty method (AHP), dispensing with the dependence on the evaluation between the decision maker's criteria, which in the case of Operation Acolhida is replaced every 5 months (contingent), making the ordering more perennial and less based on the evaluation of a decision maker.

It is observed that the first two indicators obtained a more expressive difference in relation to the other indicators, showing that they have a high degree of satisfaction for each SMART criterion.

The specificity criterion was well met in almost all indicators, having a low influence on the final ranking, except for indicator 10, which had a low evaluation in this criterion.

The analysis of the results found that two key indicators have a high degree of satisfaction.

6. Conclusion

This article aimed to integrate the AHP-Gaussian method with the SMART criteria, evaluating the indicators of a humanitarian logistics operation and allowing their ordering.

The AHP-Gaussian provided the ordering of the indicators without peer-to-peer evaluation by the decision maker, which, due to the peculiarity of the decision maker's rotation, provided a more perennial assessment of the key indicators of the operation.

Thus, the method proved to be efficient, highlighting the two main indicators of the operation that can support decisions with greater assertiveness.

In the final evaluation, it was possible to verify that the integration of the AHP-Gaussian method with the SMART criteria produced satisfactory results for ordering the indicators and suppressed the evaluation of the decision maker, making the results more sustainable.

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