PRODUÇÃO ONLINE
REVISTA CIENTÍFICA ELETRÔNICA DE ENGENHARIA DE PRODUÇÃO
ISSN 1676-1901

APLICAÇÃO DE MODELAGEM DE EQUAÇÕES ESTRUTURAIS EM OPERAÇÕES HUMANITÁRIAS: UMA REVISÃO DA LITERATURA

APPLICATIONS OF STRUCTURAL EQUATION MODELING IN HUMANITARIAN OPERATIONS: A LITERATURE REVIEW

Brenda de Farias Oliveira Cardoso* E-mail: brendafarias.eng@outlook.com
Jorge Ferreira da Silva* E-mail: shopshop@iag.puc-rio.br
*Pontifícia Universidade Católica do Rio de Janeiro (PUCRio), Rio de Janeiro, RJ

Resumo: As operações humanitárias têm o objetivo principal de salvar vidas e fornecer assistência às pessoas afetadas por desastres. Devido a alta ocorrência de desastres em todo o mundo, pesquisas no domínio de operações humanitárias têm aumentado. Ferramentas adequadas e procedimentos sistemáticos estão cada vez mais se concentrando no contexto humanitário para minimizar as dificuldades enfrentadas pelas operações. Assim, este artigo tem como objetivo revisar a literatura existente relacionada à aplicação da modelagem de equações estruturais em operações humanitárias para compreender os principais tópicos abordados pelos estudos. A revisão de 17 documentos publicados fornece análise descritiva, como evolução por ano, principais canais de publicação e o número de citações, bem como análise de conteúdo. Os resultados indicam seis tópicos principais: coordenação, gestão de desempenho, comunicação, desigualdade social, prontidão / agilidade e integração. Com base nisso, o estudo oferece algumas sugestões para pesquisas futuras.

Palavras-chave: Operações Humanitárias. Revisão da literatura. Modelagem de equações estruturais

Abstract: Humanitarian operations have the primary purpose of saving lives and providing relief to the people affected by disasters. Due to the high number of disasters that occurred worldwide, the research in the domain of humanitarian operations has increased. Adequate tooling and systematic procedures are increasingly focusing on the humanitarian context to minimize the difficulties faced by operations. Thus, this article aims to review the existing literature related to applying structural equation modeling in humanitarian operations to understand the main topics covered by the studies. A review of 17 published documents provides descriptive background, such as evolution per year, main publication channels, the number of citations, and content analysis. The results show six main topics: coordination, performance management, communication, social inequality, readiness/agility, and integration. Based on that, the study offers some suggestions for future research.

Keywords: Humanitarian Operations. Literature Review. Structural Equation Modeling

1 INTRODUCTION

Disasters displace people, disrupt lives and cause human and economic losses (DUBEY *et al.*, 2019). Over the last twenty years, between 2000 and 2019, the Centre for Research on the Epidemiology of Disasters – CRED (2020a; 2020b)

registered approximately 12,500 disasters that affected more than 6 million people. The continuous disaster occurrence reinforces the importance of humanitarian logistics and operations, focusing on minimizing the impacts caused by these events. Thus, although the risks associated with disasters exists, outcomes can be managed through efficient and effective Humanitarian Logistics (HL) (KHAN *et al.*, 2019).

HL is the process of planning, implementing, and controlling activities related to the preparation, planning, acquisition, transport, storage, tracking, and customs clearance of available resources, from the point of origin to the point of consumption, to meet the needs of the beneficiaries (THOMAS; KOPCZAK, 2005). Behl and Dutta (2018) emphasize the importance of researches in the domain of HL since natural disasters (droughts, hurricanes, floods, earthquakes) and human-made disasters (conflicts between and within nations, refugee crises, wars, fires) have a significant impact on the society globally.

Díaz *et al.* (2018) report the growing interest in disaster management research, both in the academic and professional community, to develop measures that mitigate disasters' impacts. The literature related to models, tools, and techniques in humanitarian operations is comprehensive, and the studies include different research methods, such as Structural Equation Modeling (SEM). SEM is a multivariate analysis technique with increasing Operations and Logistics application due to its adherence to complex phenomena and rigorous methodology (SANTOS *et al.*, 2020). SEM is a technique used to simultaneously analyze a group of variables, testing previously established hypotheses based on a theoretical foundation (HAIR *et al.*, 2009).

In this context, this paper aims to analyze the use of Structural Equation Modeling in studies related to humanitarian logistics and operations to identify the main topics addressed, with their respective objectives and results. The justification for the paper's development is the importance of studies that systematically investigate the advances in studies in humanitarian logistics, enabling new analyses. Besides, the study presents an integrated view of different topics covered in a humanitarian context.

Thus, this paper performs a Systematic Literature Review (SLR) to review, update, criticize, and improve knowledge on a specific topic (TORRACO, 2016). The SLR contributes to the existing literature by presenting essential results for

humanitarian operations management. Besides, the results and discussions can be the basis for the stakeholder's management in operations, focusing on the people affected by disasters and improving operations.

This paper has the following sections. After the study's introduction, justification, and objectives, the theoretical basis with concepts relevant to the research is developed in Section 2. In Section 3, the research methodology is presented, considering the steps of the SLR. Then, the results obtained through the analysis of the SLR documents are presented in Section 4. Section 5 offers the discussions and theoretical and practical implications of the study. Finally, in section 6, the conclusions and guidelines for future research consolidate and end the analysis.

2 THEORETICAL BACKGROUNDS

This section presents the bibliographic review of the main concepts related to humanitarian operations and structural equation modeling. The general concepts of humanitarian operations are presented, and the main SEM concepts are covered.

2.1 Humanitarian Operations

Humanitarian operations are related to the processes and systems involved in mobilizing resources, skills, and knowledge to help people affected by disasters (VAN WASSENHOVE, 2006). The research line emerged after the tsunami in Asia in 2004 and is the adaptation of commercial logistics activities to the humanitarian context (RUSSELL, 2005), characterizing it as an important theme, which has grown in recent years (LEIRAS *et al.*, 2014).

The humanitarian operations deal with a series of natural disasters, such as earthquakes, tsunamis, hurricanes, tornadoes, epidemics, droughts, floods, and anthropogenic disasters, such as terrorist acts, chemical attacks, refugee crises, and nuclear accidents (KOVÁCS; SPENS, 2009). Besides, humanitarian operations are related to developing programs to improve existing problems (KOVÁCS; SPENS, 2009). Therefore, in addition to alleviating human suffering, the objective of humanitarian operations focuses on finding solutions, through development

programs, to social problems such as, for example, poverty, hunger, inequality, or illiteracy.

Van Wassenhove (2006) states that for a humanitarian operation to be considered successful, it is necessary to meet the urgent needs of the population to reduce the vulnerability of the victims in the shortest possible time. Assistance to the population involves collecting and distributing basic items, such as food, clothing, shelters, and equipment for setting up camps to develop basic activities and medical care (SANTOS *et al.*, 2012).

Although studies have grown in recent years, it is still necessary to understand how the subject is approached considering systematic tools such as structural equation modeling.

2.2 Structural Equation Modeling (SEM)

SEM aims to explain the relationships between multiple variables (PILATI; LAROS, 2007; HAIR *et al.*, 2009). The technique analyzes a group of variables simultaneously, testing previously established hypotheses based on a theoretical foundation. The insertion of these conceptual variables occurs through the latent variables or constructs, which are elaborated from measurable variables. They have at least one characteristic in common, and that function as indicators of the concepts worked in the theoretical sphere (OLIVEIRA, 2016).

The analyzed models represent a phenomenon's reality and are divided into the measurement and structural models (HAIR *et al.*, 2009). The measurement model represents the theory that shows how constructs are formed through measured variables; the structural model shows the association between them (HAIR *et al.*, 2009).

SEM involves the four stages of the Confirmatory Factor Analysis process focused on the measurement model: (i) definition of individual constructs, (ii) development of the measurement model, (iii) study planning to produce empirical results, (iv) evaluation of the model validity. It also involves two specific stages aimed at the structural model: (v) specification of the structural model and (vi) evaluation of the validity of the structural model (PILATI; LAROS, 2007).

The SEM technique is a significant step forward in dealing with multiple dependency relationships. Its value is linked to the benefits of the simultaneous use of structural models and measures, each containing different purposes in the complete model's global analysis (SILVA *et al.*, 2007).

3 METHODS AND PRODEDURES

The methodological procedures of this study consider the application of a Systematic Literature Review. SLR is a research method that reviews, updates, criticizes, and improves knowledge on a specific topic, identifying strengths and weaknesses, as well as gaps and contradictions that exist (TORRACO, 2016). In the operations management area, Thomé *et al.* (2016) detail the SLR method according to eight steps:

- Planning and formulating the problem,
- Searching the literature,
- Data gathering,
- Quality evaluation,
- Data analysis and synthesis,
- Interpretation of results,
- Presenting the results, and
- Updating the review.

Considering the *first step*, the paper intends to answer the research question: how are studies of humanitarian operations approached from structural modeling equations? The application of the SLR is intended to identify and analyze constructs relevant to the area of humanitarian operations and the cause and effect relationship between variables.

The *second step* considers the bibliographic search in the Scopus and Web of Science (WoS) databases. The choice is due to the capacity for complementarity between journals indexed in the two databases (THOMÉ *et al.*, 2016; MONGEON and PAUL-HUS, 2016). The set of keywords is defined by combining two groups that cover the topic broadly enough to avoid any artificial limitation of the documents

obtained while providing limits to exclude undesirable results. The search string is: ("structural equation modeling" OR "SEM") AND ("disaster operation" OR "relief operation" OR "humanitarian logistic" OR "development program" OR "humanitarian operation" OR "humanitarian assistance" OR "humanitarian aid" OR "assistance logistic").

It is essential to highlight that no limitation is adopted regarding the period, covering all years of publications to reach many documents. Also, a filter related to publication type is not applied to obtain all types of documents related to the subject. The search returns 185 documents on March 28 of 2021, and the documents are analyzed according to the following criteria to decide for the inclusion or exclusion in the present research:

- Inclusion criteria: address the structural equations modeling in the humanitarian context;
- Exclusion criteria: does not address the structural equations modeling in the humanitarian context; develops research outside the humanitarian context; deals with post-disaster medical assessments; duplicated documents; documents in other languages than English.

The data collection stage is carried out by identifying and compiling auxiliary tables of the elements sought in the works. The elements extracted from the selected documents are general and specific information from the publications. General information refers to the title, authors, year of publication, publication channels, and a number of citations. The specific information is related to the study's objective, main results, sample, and place of application.

The detailed description of the SLR ensured the quality evaluation stage. Besides, the quality assessment stage is ensured by using peer-reviewed articles in RSL, which are documents of high quality according to Thomé *et al.* (2016). Seuring and Gold (2012) explain that peer-reviewed articles represent an important mode of communication and can be considered units of analysis. The survey also considers "gray literature" publications, which are important to avoid bias in the type of publication.

The *fifth stage*, analysis, and synthesis are performed through full paper reading to identify essential aspects for interpreting the papers, as indicated by Seuring and Gold (2012). The next step consists of interpreting the results that include discussing how the topics are being addressed by the studies analyzed.

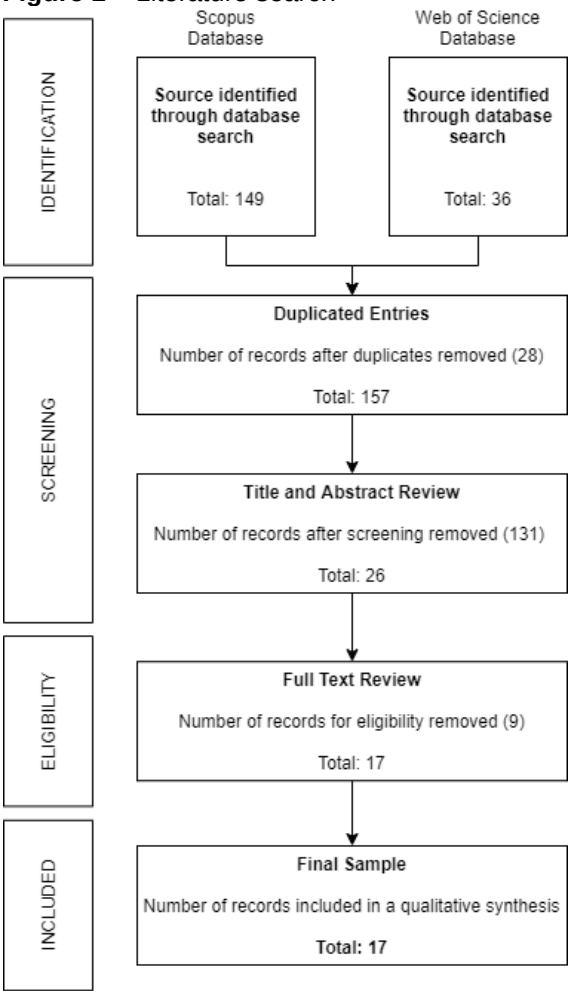
The analysis stage, according to Seuring and Gold (2012), consists of techniques related to the systematic interpretation of texts and can be performed qualitatively or quantitatively, identifying descriptive aspects of the works and analyzing the content systematically, with identification and categorization of the most important points for the interpretation of the results.

Thus, the analysis stage involves descriptive characteristics and content analysis of the documents selected in the SLR. The synthesis stage presents the material categorization to synthesize the application of structural equation modeling in humanitarian operations.

The presenting of results stage is carried out by writing in a paper format, consisting of an introduction, theoretical background, methodological procedures, analysis and discussions of the results obtained and final considerations. The update step is proposed as future research.

Figure 1 summarizes the steps using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram, proposed by Moher *et al.* (2009).

Figure 1 – Literature search

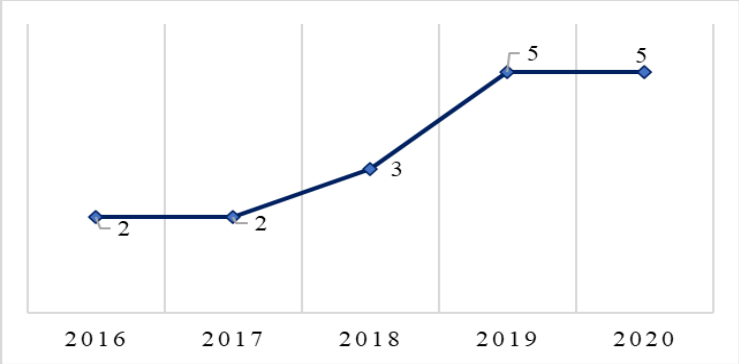


Source: Authors (2021).

4 LITERATURE RESULTS

Figure 2 presents the evolution of the number of publications per year. Based on Figure 2, it is possible to notice that the first research related to the topic was published in 2016. After 2017 the number of studies increased and reached the most significant number of publications in 2020, with five publications. Also, it is observed that the topic is addressed as an object of study in at least one publication per year since 2016.

Figure 2 – Evolution of publications per year



Source: Authors (2021).

Table 1 summarizes the 17 final documents selected, presenting the authors, year of publication, and periodic.

Table 1 – Summary of papers

Authors	Source
Khan *et al.* (2020)	
Namagembe S. (2020)	
Shafiq and Soratana (2020)	Journal of Humanitarian Logistics and Supply Chain Management
Ahmed *et al.* (2019)	
Villa *et al.* (2017)	
Khan *et al.* (2019)	Sustainability (Switzerland)
Marcu *et al.* (2018)	
Dubey *et al.* (2019)	Annals of Operations Research
Dubey *et al.* (2020)	
Behl *et al.* (2020)	The TQM Journal
Behl and Dutta (2019)	Benchmarking
Siburian (2019)	Applied Economics Letters
Berzin *et al.* (2018)	Child and Youth Services
Pazirandeh and Maghsoudi (2018)	Journal of the Operational Research Society
Kabra *et al.* (2017)	Telematics and Informatics
Bardhan and Dangi (2016)	Global Business Review
Maghsoudi and Pazirandeh (2016)	Supply Chain Management

Source: Authors (2021).

Table 1 shows that the Journal of Humanitarian Logistics and Supply Chain Management stands out with 5 publications. In addition to specific journals in the humanitarian logistics area, the topic is also addressed by journals from other areas, for example, supply chain management, business, economics, and information technology, which can characterize the theme as multidisciplinary, seen from different perspectives.

Table 2 presents the number of citations extracted from the Scopus database. The most cited paper is Dubey *et al.* (2019), which addresses swift trust and

commitment to coordination in humanitarian operations. Due to some characteristics of humanitarian operations (e.g., urgency, need for prompt service, scarce resources), stakeholders have to coordinate and trust each other to achieve goals. Also, coordination between stakeholders in operation decides an operation's success (DUBEY *et al.*, 2019).

Maghsoudi and Pazirandeh (2016) deal with key points for performance evaluation. One explanation for this may be that performance management is still a challenge for humanitarian organizations (DE FARIAS *et al.*, 2020). Kabra *et al.* (2017) address the adoption of technologies by humanitarian organizations. The adoption of technologies as an integral part of daily activities allows humanitarian organizations to improve the level of education, skills, and facilitation with other resources (KABRA *et al.*, 2017).

Table 2 – Number of citations

Authors	Number of citations	Authors	Number of citations
Dubey *et al.* (2019)	51	Bardhan and Dangi (2016)	6
Maghsoudi and Pazirandeh (2016)	40	Shafiq and Soratana (2020)	4
Kabra *et al.* (2017)	30	Marcu *et al.* (2018)	3
Pazirandeh and Maghsoudi (2018)	12	Namagembe (2020)	1
Khan *et al.* (2019)	10	Khan *et al.* (2020)	1
Villa *et al.* (2017)	9	Behl *et al.* (2020)	1
Behl and Dutta (2019)	9	Siburian (2019)	0
Ahmed *et al.* (2019)	8	Berzin *et al.* (2018)	0
Dubey *et al.* (2020)	7		

Source: Authors (2021).

Table 3 presents a summary of the documents selected in the SLR. After full reading, documents were classified into six main topics: (1) coordination, (2) performance management, (3) communication, (4) social inequality, (5) readiness/agility, and (6) integration.

Table 3 – Summary papers select by SLR (continue)

Topic	Reference	Objective	Results	Sample size Country/Region
1	Pazirandeh and Maghsoudi (2018)	Analyze the link between resource sharing, aspects that affect resource sharing and operational performance of organizations, including coordination	Resource sharing can improve organizational performance, and this complementarity of resources between organizations increases your willingness to share resources.	101 humanitarian organizations (Southeast Asia)
	Dubey *et al.* (2019)	Understand the impact of information sharing and the formation of a network for coordination in humanitarian supply chains	Information sharing and behavioral uncertainty reduction act as facilitators for quick confidence.	187 Humanitarian officers and managers (India)
	Ahmed *et al.* (2019)	Understand how coordinated effort effects Resources Management (RM).	Swift Trust helps to improve coordination and commitment from all stakeholders in order to manage resources to lead effective relief operations.	82 humanitarian workers (Pakistan)
	Namagembe (2020)	Examine the influence of relational capital on coordination between groups and the provision of services by humanitarian organizations	Relational capital influences inter-cluster coordination and service delivery in humanitarian relief chains.	60 humanitarian organizations (Different countries
	Dubey *et al.* (2020)	Explores the relationships between information sharing, rapid trust and commitment to achieve coordination.	Swift-trust influences coordination in such networks but the mechanism that leads to coordination has not been explained before. Our study provides an avenue to understand how information sharing helps build trust quickly.	147 organizations (India)
2	Maghsoudi e Pazirandeh (2016)	Investigate the association between visibility, resource sharing and performance in humanitarian supply chains	Supply chain visibility has a significant impact on organizational performance and will increase the improvement in cost efficiency and the flexibility in delivering aid to beneficiaries.	101 humanitarian organizations (Southeast Asia)
	Bardhan e Dnagi (2016)	Establish a relationship between Critical Success Factors (CSFs) for relief logistics with the performance of the overall relief effort.	CFFs were classified as follows: level of coordination, behavioral factors, level of preparation, and needs assessment. The coordination level was considered to be the most significant.	200 relief providers 100 affected population (India)
	Khan *et al.* (2019)	Understand how transparency can improve the performance, efficiency and effectiveness of humanitarian logistics	Public confidence is essential in improving the performance, efficiency and effectiveness of humanitarian logistics.	210 humanitarian workers (Pakistan)

Table 3 – Summary papers select by SLR (continue)

Topic	Reference	Objective	Results	Sample size Country/Region
3	Behl *et al.* (2020)	Explore the role of dialogic public communication and information quality (IQ) in evaluating the operational performance of donation-based crowdfunding (DBC) tasks	Operational performance is explained by the quality of information and its association with dialogic public communication; cognitive trust positively moderates the relationship between IQ and organizational public dialogic communication and operational performance; duration of the DBC task has no significant control over dialogic public communication.	203 responses from multiple crowdfunding platforms (Different countries)
	Khan *et al.* (2020)	Analyzes how teaching HL at the university can support increase operations performance and minimize suffering	Association between the (HLP) is mediated by sustainability, and that the teaching of HL at university plays a vital role in enhancing HLP and is therefore a very suitable approach for sustainable development in HL.	207 managers, teachers, students and professionals (Pakistan)
	Villa et al (2017)	Understand the impact of effective communication mechanisms on the performance of humanitarian organizations	The use of internal manuals and procedural guidelines, along with formal strategies is essential to promote dialogue with stakeholders and increase the perceived performance of humanitarian programs	107 humanitarian workers (Somalia)
	Kabra *et al.* (2017)	Examine how technology adoption can improve communication in humanitarian organizations	Of the four constructs analyzed (expected performance, expected effort, social influence and enabling conditions), expected performance and expected effort significantly affect the adoption of information technology	192 humanitarian practitioners (India)
4	Behl and Dutta (2019)	Explore how information quality moderates the relationship of Corporate Social Responsibility (CSR) and crowdfunding to achieve financial and social stability	Corporate social responsibility can support the disaster relief operation, as there is a positive effect on corporate social responsibility activities in collective funding based on donations	232 respondents (India)
	Siburian (2019)	Investigate the effects of fiscal decentralization on social income inequality	Decentralization allows for a balance in the distribution of resources to design a personalized development program that meets local needs	Database (Indonesia)
	Berzin *et al.* (2018)	Understand the relationship between a low-income youth entrepreneurship program and positive youth outcomes	Entrepreneurship and business creation can be important mechanisms to support marginalized youth	129 young (Different countries)
5	Shafiq and Soratana (2020)	Present a Lean Readiness Assessment Model (LRAM) to assess the readiness of Humanitarian Organizations (HO) to adopt Lean Management (LM) practices	The critical factors accepted for LRAM are: process management, planning and control management, customer relationship management, human resource management and communication and coordination management	180 experts (Different countries)

Table 3 –Summary papers select by SLR (conclusion)

Topic	Reference	Objective	Results	Sample size Country/Region
	Dubey *et al.* (2020)	Understand how-swift trust, commitment and collaboration among the humanitarian actors improve the agility in humanitarian supply chains	Information sharing and supply chain visibility is key to agility in humanitarian supply chains	147 NGOs (India)
6	Marcu *et al.* (2018)	Identify possible ways of integrating immigrants and increase the performance of the labor market	Active labor market policies, the achievement of secondary education and advances in well-being, can generate a reduction in the unemployment rate of the foreign population	Database (European Union)

Source: Authors (2021).

Coordination is the most discussed topic, highlighted in four publications. One explanation can be the number of stakeholders involved (LEIRAS *et al.*, 2014; PAZIRANDEH; MAGHSOUDI, 2018; FONTAINHA *et al.,* 2017). Humanitarian operations have different stakeholders: military, government, legislative and regulator, private sector, direct supplier, media, international aid network, donors, local aid network, and the beneficiary (FONTAINHA *et al.*, 2017). Pazirandeh and Maghsoudi (2018) explain that organizations are different, with different objectives, cultures, and work procedures that need to compete for resources. One of the solutions to achieve coordination can be the sharing of resources to achieve better results. Corroborating this statement, Ahmed *et al.* (2019) indicates that sharing timely information among stakeholders is essential to boost rapid response logistics efficiently, reducing behavioral uncertainty and increasing rapid confidence, which accelerates commitment through strong coordination. Dubey *et al.* (2019) claim that coordination between stakeholders defines the success of a humanitarian operation. One aspect that can influence coordination is relational capital, where coordination between groups partially mediates the relationship between relational capital and service delivery in humanitarian aid chains.

The **performance management** topic is still a challenge for humanitarian organizations (SHAFIQ; SORATANA, 2019; DE FARIAS *et al.*, 2020). Bardhan and Dnagi (2016) state that a performance measurement system is needed for proper management of operations that identifies problem areas and provides guidance for improvement. Among the indicators considered crucial to the success of activities, behavioral factors, especially leadership, are significant. Maghsoudi and Pazirandeh (2016) point out some difficulties for excellent performance, mainly related to information uncertainty (supply, demand, intensity, and location) during disasters, which is considered a significant moderating factor for performance. Some factors influence operations' performance: sharing resources, assessing needs, receiving feedback from specialists, regularly participating in coordination meetings, and logistical infrastructure. Khan *et al.* (2019) affirm that it is vital that humanitarian service providers adjust, modify and reconfigure their activities, improving their performance, efficiency and effectiveness through transparency (disclosure, clarity

and precision, and the components of transparency, such as corporate governance, decision making decision and responsibility).

Regarding the **communication** topic, Villa *et al.* (2017) claim that better communication strategies within organizations and other stakeholders are essential to result in more efficient programs. Kabra *et al.* (2017) indicate that the adoption of information technology in the humanitarian context is necessary to improve communication between those involved; therefore, organizations must initiate additional support and training programs that emphasize the benefits of using information technology to improve communication and improve results. Behl and Dutta (2019) indicate that the quality of information positively affects the relationship between crowdfunding and social assistance and the financial aid offered to disaster victims. Therefore, timely and quality information helps to achieve resilience.

Regarding **social inequality**, Siburian (2019) states that fiscal decentralization better meets local demands for public goods since local authorities have more knowledge than people need in their activities. The imbalanced regional distribution of natural resources, human capital, and infrastructure can increase social inequality. Berzin *et al.* (2018) affirm that young people who participate in development programs have higher levels of financial literacy, project management, interactions with the community, and leadership on the experience of young people.

Concerning **readiness/agility,** Shafiq and Soratana (2020) state that Lean Management's adoption is a valuable tool for humanitarian organizations since it is a proven philosophy that encompasses the continuous improvement of supply chain management. In this case, the crucial factors are process management, planning and control management, customer relationship management, human resource management, and communication and coordination management.

About **integration**, Marcu *et al.* (2018) state that there is a great need to develop specific and distinct policies for migrant workers and asylum seekers/refugees to contribute to their performance in the labor market. Local authorities have a crucial role in integrating migrants into their new communities; therefore, there is a need to obtain better evidence for developing new policies for the integration of migrants.

5 DISCUSSIONS AND IMPLICATIONS

The results presented in this paper contribute to the theoretical foundation of the main topics of LH analyzed with the application of SEM: coordination, performance management, communication, social inequality, readiness/agility, and integration. Among the documents analyzed, many are related to the difficulty of coordination during disaster response actions.

This result reinforces that improving coordination between organizations is essential to minimize the vulnerable population's negative impacts. Coordination between stakeholders with different profiles, cultures, interests, and methodologies depends on a broad understanding of disaster response and standardization processes (FONTAINHA *et al.*, 2017; FONTAINHA *et al.*, 2020).

The results also indicate the prevalence of research carried out on the Asian continent; therefore, there is a need for further studies and analysis, considering other regions such as developing countries. In developing countries, most of the population lives in areas with a high risk of disasters and other vulnerable conditions linked to the structure, economy, physical infrastructure, and socioeconomic characteristics of families such as income, health, and education (Zorn, 2018). Specifically in America Latina, according to the 2018 Social Panorama of Latin America, more than 60 million people live in extreme poverty in these countries (ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN – ECLAC, 2019), resulting in a large population vulnerable to disasters. Also, in recent years, a large number of disasters attain Latin American countries: earthquakes in Haiti and Chile in 2010, Ecuador in 2016, Peru in 2019, the landslides in the mountainous region in Brazil in 2011, floods in Uruguay in 2014, Hurricane Willa in Mexico in 2018, landslides land in Colombia in 2017 and Bolivia in 2019. Also, human-made disasters such as the refugee crisis in Venezuela, dam break in Mariana in 2015 and Brumadinho in 2019 (Brazil), political problems in Bolivia, Colombia, and Chile, and others.

The research aims to generate knowledge for researchers and society in general and motivate reflections on possible improvements necessary for the success of humanitarian operations. The studies that address SEM in the

humanitarian context help understand the causal relationships, explaining how the variables correlate to producing a specific outcome.

Besides, the research also offers additional and specific contributions to each group for both academics and practitioners, as detailed in the following.

This study contributes to the academic literature with a structured review of SEM's application in humanitarian operations, which includes an analysis of the main objectives and results of the analyzed studies. In this way, it is possible to observe the most approached themes and identify the research gaps that can be worked on in new practical applications.

The developed literature review allows us to identify where the state of knowledge on the subject is. In this way, it is possible to observe the models, analyzes, and results already established, in addition to understanding the issues that have not yet been investigated. Therefore, this study contributes to the literature with relevant results on the topic and contributes to researchers, assisting in defining the most appropriate research strategy to investigate that problem and the most pertinent data analysis to be adopted. It is, therefore, an essential step by which the researcher can start his work.

Regarding the practical implications, the study's development allows humanitarian workers, directors, and managers to identify the main variables that contribute to operations' success. The results presented in the study as, for example, swift-trust and commitment influence coordination in humanitarian operations (DUBEY *et al.*, 2019), and resource sharing can improve organizational performance (PAZIRANDEH; MAGHSOUDI, 2018). The results can support organizations in adapting their processes and activities to improve the operation as a whole.

Besides, this study can support the design and implementation of systems that meet the main needs for improving humanitarian activities, based on identifying some fundamental variables to the provision of services. Thus, this study represents an opportunity to enhance the services offered and, consequently, stakeholder satisfaction.

6 CONCLUSIONS

Identifying the current state of the art related to the application of structural equation modeling in the humanitarian context was achieved. In the SLR steps' application, 17 documents were analyzed according to descriptive aspects for the year, journals, most cited articles, and content analysis.

Although the SEM technique has several benefits for decision-making, the results reveal that the topic is not addressed enough in the humanitarian context's academic literature. The results also show that SEM's application covers six main research topics: coordination, performance management, communication, social inequality, readiness/agility, and integration. The coordination topic is the most addressed by the studies due to the difficulties that humanitarian operations impose, mainly due to the number of actors involved in response actions. For this reason, the dissemination of collaboration mechanisms between organizations is essential to improve results.

Suggested future research should consider the need to address other areas, such as supplier selection, inventory management, and facilities location. On the other hand, cross-countries studies are more than welcome to better understand geographical impacts due to different regions. Also, it is suggested that future research update the literature review, consider other document types and sources (e.g., reports from international humanitarian organizations), and develop empirical studies for results validation.

7 ACKNOWLEDGEMENTS

Coordination for the Improvement of Higher Education Personnel (CAPES) [88887.373163/2019-00 – Finance Code 001].

REFERENCES

AHMED, W., NAJMI, A., KHAN, F., & AZIZ, H. Developing and analyzing framework to manage resources in humanitarian logistics. **Journal of Humanitarian Logistics and Supply Chain Management**, v. 9 n. 2, p. 270-291, 2019. https://doi.org/10.1108/JHLSCM-01-2019-0012

BARDHAN, A. K.; DANGI, H. K. Drivers and indicators of performance in relief chain: An empirical study. **Global Business Review**, v. 17, n. 1, p. 88-104, 2016. https://doi.org/10.1177/0972150915610693

BEHL, A.; DUTTA, P. Social and financial aid for disaster relief operations using CSR and crowdfunding. **Benchmarking: An International Journal**, v. 27, n. 2, p. 732-759, 2019. https://doi.org/10.1108/BIJ-08-2019-0372

BEHL, A.; DUTTA, P.; SHEOREY, P.; SINGH, R. K. (2020). Examining the role of dialogic communication and trust in donation-based crowdfunding tasks using information quality perspective. **The TQM Journal**, p. 1754-2731. https://doi.org/10.1108/TQM-06-2020-0139

BEHL, A.; DUTTA P. Humanitarian supply chain management: A thematic literature review and future directions of research. **Annals of Operations Research,** p.1-44, 2018. https://doi.org/10.1007/s10479-018-2806-2

BERZIN, S. C.; LEE, H.; LEONG, A. D. Social entrepreneurship as intervention: Findings from a venture development program for marginalized youth. **Child & Youth Services**, v. 39, n. 4, p. 211-227, 2018. https://doi.org/10.1080/0145935X.2018.1485094

CRED, CENTRE OF RESEARCH FOR THE EPIDEMIOLOGY OF DISASTERS (2020a), **Human cost of disasters:** an overview of the last 20 years 2000 – 2019, available at: https://www.emdat.be/publications .accessed in: Mar 16, 2020.

CRED, CENTRE OF RESEARCH FOR THE EPIDEMIOLOGY OF DISASTERS (2020b) **CRED Crunch 60**: technological disasters, available at: https://www.emdat.be/publications. Aaccessed in: Mar 16, 2020.

DE FARIAS OLIVEIRA CARDOSO B., FONTAINHA T.C., LEIRAS A. Performance indicators in humanitarian operations from the beneficiary perspective: a systematic literature Review. *In*: LEIRAS A., GONZÁLEZ-CALDERÓN C., DE BRITO JUNIOR I., VILLA S., YOSHIZAKI H. (eds) Operations Management for Social Good. POMS 2018. *In*: BUSINESS AND ECONOMICS. [**Proceedings…**]. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-23816-2_27

DÍAZ, H. L.; IMITOLA, K. A.; ROBLES, M. A. B.; NIÑO, P. N. N.; QUEZADA, D. O. M. A memetic algorithm for location routing problem with time windows for the attention of seismic disasters: a case study from Bucaramanga, Colombia. **INGE CUC** v. 14, n. 1, p. 75-86, 2018. https://doi.org/10.17981/ingecuc.14.1.2018.7

DUBEY, R.; ALTAY, N.; BLOME, C. Swift trust and commitment: The missing links for humanitarian supply chain coordination? **Annals of Operations Research**, v. 283, n. 1, p. 159-177, 2019. https://doi.org/10.1007/s10479-017-2676-z

DUBEY, R.; BRYDE, D. J.; FOROPON, C.; GRAHAM, G.; GIANNAKIS, M.; MISHRA, D. B. Agility in humanitarian supply chain: an organizational information processing perspective and relational view. **Annals of Operations Research,** p. 1-21, 2020. https://doi.org/10.1007/s10479-020-03824-0

ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN (ECLAC). **Social Panorama of Latin America**, 2018 (LC/PUB.2019/3-P), Santiago, 2019.

FONTAINHA, T. C.; LEIRAS, A.; BANDEIRA, R. A. M.; SCAVARDA, L. F. Public-Private-People Relationship Stakeholder Model for disaster and humanitarian operations. **International Journal of Disaster Risk Reduction** v. 22, p. 371-386, 2017. https://doi.org/10.1016/j.ijdrr.2017.02.004

FONTAINHA, T. C., SILVA, L. D. O., DE LIRA, W. M., LEIRAS, A., BANDEIRA, R. A. D. M., & SCAVARDA, L. F. Reference process model for disaster response operations. **International Journal of Logistics Research and Applications**, p. 1-26, 2020. https://doi.org/10.1080/13675567.2020.1789080

HAIR, J. F.; BLACK, W. C.; BABIN, B. J.; ANDERSON, R. E.; TATHAM, R. L. **Análise multivariada de dados**. 6. ed. Porto Alegre: Bookman, 2009.

KABRA, G.; RAMESH, A.; AKHTAR, P.; DASH, M. K. (2017). Understanding behavioural intention to use information technology: Insights from humanitarian practitioners. **Telematics and Informatics**, v. 34, n. 7, p. 1250-1261, 2017. https://doi.org/10.1016/j.tele.2017.05.010

KHAN, M.; LEE, H. YONG, B.; JUNG H. The Role of Transparency in Humanitarian Logistics. **Sustainability**, v. 11, n. 7, p. 2078, 2019. https://doi.org/10.3390/su11072078

KHAN, M.; SARMAD, M.; ULLAH, S.; BAE, J. Education for sustainable development in humanitarian logistics. **Journal of Humanitarian Logistics and Supply Chain Management**, p. 2042-6747, 2020. https://doi.org/10.1108/JHLSCM-03-2020-0022

KOVÁCS, G.; SPENS, K. Identifying challenges in humanitarian logistics. **International Journal of Physical Distribution & Logistics Management**, v. 39, n. 6, p. 506-528, 2009. https://doi.org/10.1108/09600030910985848

LEIRAS, A.; BRITO JR, I.; PERES, E. Q.; BERTAZZO, T. R.; YOSHIZAKI, H. T. Y. Literature review of humanitarian logistics research: trends and challenges. **Journal of Humanitarian Logistics and Supply Chain Management,** v. 4, n.1, p. 95-130, 2014. https://doi.org/10.1108/JHLSCM-04-2012-0008

MAGHSOUDI, A.; PAZIRANDEH, A. Visibility, resource sharing and performance in supply chain relationships: insights from humanitarian practitioners**. Supply Chain Management: An International Journal**, v. 21, n. 1 p. 125 – 139, 2016. https://doi.org/10.1108/SCM-03-2015-0102

MARCU, N.; SIMINICĂ, M.; NOJA, G. G.; CRISTEA, M.; DOBROTĂ, C. E. Migrants' integration on the european labor market: a spatial bootstrap, sem and network approach. **Sustainability**, v. 10, n. 12, p. 4543, 2018. https://doi.org/10.3390/su10124543

MONGEON, P.; PAUL-HUS, A. The journal coverage of web of science and scopus: a comparative analysis. **Scientometrics,** v. 106, p. 213-228, 2016. https://doi.org/10.1007/s11192-015-1765-5

MOHER, D., LIBERATI, A., TETZLAFF, J., ALTMAN, D.G., Prisma Group. Preferred reporting Items for systematic reviews and meta-analyses: the PRISMA statement. **PLoS Med.** v. 6, n. 7, 2009. https://doi.org/10.1371/journal.pmed.1000097

NAMAGEMBE, S. Enhancing service delivery in humanitarian relief chains: the role of relational capital. **Journal of Humanitarian Logistics and Supply Chain Management**, v. 10, n. 2, p. 169-203, 2020. https://doi.org/10.1108/JHLSCM-06-2019-0038

OLIVEIRA, P. H. G. **Modelagem de equações estruturais aplicada ao estudo das relações entre qualidade e diversidade da fauna no sistema solo-serapilheira.** (Tese de doutorado) - Centro de Ciências e Tecnologias Agropecuárias – Universidade Estadual do Norte Fluminense Darcy Ribeiro, 2016.

PAZIRANDEH, A.; MAGHSOUDI, A. Improved coordination during disaster relief operations through sharing of resources. **Journal of the operational research society**, v. 69, n. 8, p. 1227-1241, 2018. https://doi.org/10.1080/01605682.2017.1390530

PILATI, Ronaldo; LAROS, Jacob Arie. Modelos de equações estruturais em psicologia: conceitos e aplicações. **Psicologia: teoria e pesquisa**, v. 23, n. 2, p. 205-216, 2007. https://doi.org/10.1590/S0102-37722007000200011

RUSSELL, T. E. The humanitarian relief supply chain: analysis of the 2004 south east asia earthquake and tsunami. **MLog Thesis**, MIT, 2005.

SANTOS, H. G. D., NASCIMENTO, C. F. D., IZBICKI, R., DUARTE, Y. A. D. O., CHIAVEGATTO FILHO, P.; DIAS, A. Machine learning para análises preditivas em saúde: exemplo de aplicação para predizer óbito em idosos de São Paulo, Brasil. **Cadernos de Saúde Pública**, 35, e00050818, 2019. https://doi.org/10.1590/0102-311x00050818

SEURING, S.; GOLD, S. Conducting content-analysis based literature reviews in supply chain management. **Supply Chain Management: An International Journal,** v.17, n.5, p. 544-555, 2012. https://doi.org/10.1108/13598541211258609

SHAFIQ, M., & SORATANA, K. Lean readiness assessment model–a tool for Humanitarian Organizations' social and economic sustainability. **Journal of Humanitarian Logistics and Supply Chain Management,** v. 10, n. 2, 2020. https://doi.org/10.1108/JHLSCM-01-2019-0002

SIBURIAN, M. E. Fiscal decentralization and regional income inequality: evidence from Indonesia. **Applied Economics Letters,** v. *27*, n.17, p.1383-1386, 2020. https://doi.org/10.1080/13504851.2019.1683139

SILVA, J. F., COSTA, L. S. V., & LANZER, E. A. Considerações sobre a aplicação da modelagem de equações estruturais em Estratégia**.** *In***:** ENCONTRO NACIONAL DA ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO EM ADMINISTRAÇÃO**,** 31., 2007. [**Anais...**]. 2007.

TORRACO, R. J. Writing integrative literature reviews: Using the past and present to explore the future", **Human Resource Development Review**, v. 15, p. 404-428, 2016. https://doi.org/10.1177/1534484316671606

THOMÉ, A. M. T.; SCAVARDA, L. F.; SCAVARDA, A. J. Conducting systematic literature review in operations management. **Production Planning & Control,** v. 27, n. 5, p. 408-420, 2016. https://doi.org/10.1080/09537287.2015.1129464

VAN WASSENHOVE, L. N. Humanitarian aid logistics: supply chain management in high gear. **Journal of the Operational Research Society**, v. 57, n. 5, p. 475-489, 2006. https://doi.org/10.1057/palgrave.jors.2602125

VILLA, S., GONÇALVES, P., & ODONG, T. V. Understanding the contribution of effective communication strategies to program performance in humanitarian organizations. **Journal of**

Humanitarian Logistics and Supply Chain Management, v. 7 n. 2, p. 126-151, 2017. https://doi.org/10.1108/JHLSCM-05-2016-0021

ZORN, M. Natural Disasters and Less Developed Countries. **Nature, Tourism and Ethnicity as Drivers of (De) Marginalization. Springer, Cham**, v. 3, p. 59-78, 2018. https://doi.org/10.1007/978-3-319-59002-8_4

Artigo recebido em: 01/06/2021 e aceito para publicação em: 06/12/2021
DOI: https://doi.org/10.14488/1676-1901.v21i4.4347