Post-Disaster Humanitarian Logistics in Natural Disasters: A Systematic Review

Sambudi Hamali, Helen Purnama Hutahaean, Kezia Audrey Widjaja
Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University, Jl. K.H. Syahdan No. 9, Palmerah, Jakarta 11480, Indonesia
sambudi_hamali@binus.ac.id, helenpurnama263@gmail.com, keziaaw@yahoo.com

Abstract

The purpose of this research is to determine the challenges that hinder the Humanitarian Logistics (HL) process of natural disasters, the causes of the challenges that often arise from natural disasters, and the methods applied to solve these problems. The methods used in this research are a Systematic Literature Review, Publish or Perish 7 application (data analysis method), and the Scopus Search option. The researchers found that the challenges hindering the process of HL are location, network, waste management, and financial funds. Causes of these challenges are generally uncertainty, constraints and immobility, limited resources, and failure of minor problems (such as lack of appropriate responses, delay times, personnel shortages, injustice, and conflict/competition). Methods that are applied to these challenges mostly consist of mathematical models, the articles that don't use mathematical models usually focus on potential solutions, or already have clear solutions.

Keywords
Humanitarian Logistics, Post Disaster Challenges, Post Disaster Methods, Causes Post Disaster, Natural Disaster

1. Introduction
Since the 1950s, both the number affected and the magnitude of disasters have continued to increase, averaging around 235 million people per year since the 1990s (Boonmee, Arimura, & Asada, 2017). The degree and impact of natural disasters have increased dramatically in recent decades due to population growth, global trends in urbanism, land use, and ecosystem pressures (Tofighi, Torabi, & Mansouri, 2016). According to Xu, Wang, Shen, Ouyang, & Tu (2016) it is explained that a natural disaster is a catastrophic event with an atmosphere, with geological and hydrological origins such as drought, earthquakes, floods, hurricanes, landslides that can cause death, property damage and social environment disturbance. Furthermore, according to Cozzolino, Wankowicz, & Massaroni (2017), the sudden trend of natural disasters can be considered as the reason for the increasing interest in humanitarian logistics among academics and professionals.

In the world of logistics, a disaster condition is known as humanitarian logistics. The definition of humanitarian logistics is the process of evacuating people whose area of living is hit by a disaster by implementing and controlling the flow of goods and materials that are efficient, cost-effective, and collect information from the point of origin to the point of consumption for the purpose of alleviating people's suffering (Boonmee, Arimura, M., & Asada, 2017). In situations of natural disasters, it can be categorized according to the types of disasters as described by Harrison & Johnson (2016), namely the pre-disaster period with the mitigation and preparedness phase, and a post-disaster period with the response and recovery phase. From a review of the literature, it has been observed that there is still much to learn about effective relief operations, especially in post-disaster situations. According to Banomyong, Varadejsatitwong and Oloruntoba (2019) it was found that generally, literature reviews focus mainly on the mitigation and preparedness phases, however only eight papers specifically discuss the recovery phase in post-disaster. They explained that this topic was still lacking, due to the lack of post-disaster links with humanitarian logistics. Ransikarbum & Mason (2016) argues that, although research on humanitarian logistics has recently increased, those examining the response and recovery phases in post-disaster operations are few and far between.

Based on the description above, the authors are interested in conducting a systematic literature review (SLR) on topics related to humanitarian logistics post-disaster related to challenges, the causes of challenges that arise, and methods for solving post-disaster challenges. This SLR focuses on 2010 - 2020 because of research on humanitarian logistics post-disaster in Scopus indexed journals from 2010 until now. The authors use Scopus because according to Montoya, Alcayde, Baños, & Manzano (2018) journals or scientific articles that have been indexed by Scopus have gone through a very strict selection. The quality and credibility of a journal will be carefully viewed and reviewed before it is indexed into the Scopus database.

1.1. Objectives

The purpose of this study is:

1. To find out challenges hinder the process of Humanitarian Logistic Post-Disaster (HLPD)in natural disasters.
2. To find out the causes of the challenges that often arise after a natural disaster.
3. To find out the methods that can be applied to help solve problems that occur after disasters in natural disasters

2. Research Methodology

This study uses a Systematic Literature Review (SLR) method to identify, classify, and analyze literature. A Systematic Literature Review (SLR) is a critical evaluation and assessment of all research that addresses a specific topic or problem. SLR is a literature review method that adopts a series of steps to ensure that the proper precision and transparency is brought into a research process (Albliwi, Antony, & Lim, 2015). SLRs can summarize existing evidence, identify gaps and directions for future research (Bhimani, Mention, & Barlatier, 2019). The purpose of the literature review is to present a treatment that can be verified and does not deviate from a research topic using a rigorous methodology that can be produced and developed (Rizzo et al., 2017).

In making this SLR, the authors adopt the SLR method used by Durach, CF, Kembro, J., & Wieland, A. (2017) where there are a total of 6 steps. The first step is defining the research question. This step is a starting point for defining the research question that becomes the research topic. The second step is determining the required characteristics of primary studies. This step is where it develops according to the criteria of the research question. The third step is retrieving a sample of potentially relevant literature to determine the data retrieval procedure. Define keywords to retrieve data that match the criteria. The fourth step is to select the pertinent literature. This step is to filter data that fits the research criteria and minimize those that are not suitable. The fifth step is synthesizing the literature. This step is to extract data related to literature information. The sixth step is reporting the results. This step is a report on the results of the literature review that has been made. We will analyze the data we have collected on this topic and identify differences in the definition and humanitarian logistics data compared to others, until we can finally induce definitions and humanitarian logistics data. (Vicente-Saez, & Martinez-Fuentes, 2018). In this study the authors used six steps in the systematic literature review.

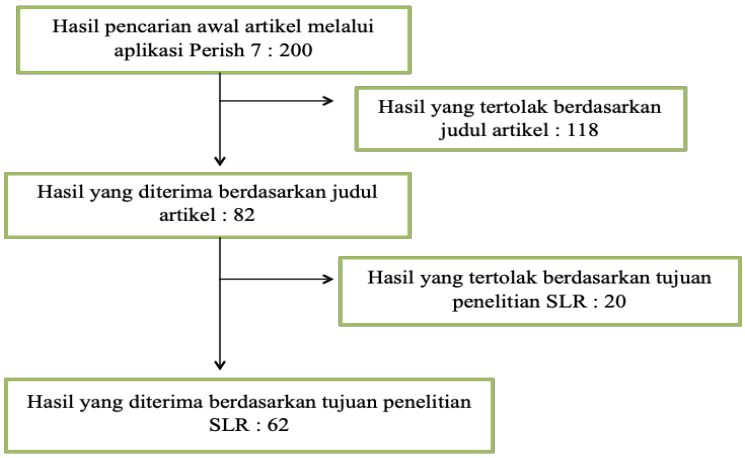

Figure 1. SLR Research Process

The search for research journals uses the Publish or Perish7 software with the keywords "Humanitarian Logistics" and "Post-Disaster". From the journal search results, there are a total of 62 journals that were obtained, which were then entered into Microsoft Excel to be filtered using the journal mapping. For the journal mapping stage, the authors make decisions based on the criteria, namely the results of a database search that produces several articles to enable in-depth analysis of the articles that are obtained.

3. Results and Discussion

Based on the final search results, there were 62 relevant articles regarding the quality of the data. It can be seen that the analysis of each article obtained from 2010-2020 explains the significance of each article with relevant data from 2010 to 2020. This analysis is carried out for each journal so that an explanation can be obtained in order to discuss the research objectives based on a certain type of disaster which is natural disasters (in general). These research objectives are the challenges or problems that hinder the process of HL-PD, the causes of challenges that often arise, and the methods or solutions used in each of these journals.

The first research examines the challenges that hinders the humanitarian logistics process in post-disaster situations during natural disasters. The challenge is focused on each article with the hope of avoiding any problems or challenges faced by the recipients of aid or humanitarian logistics in overcoming these problems or challenges. The second research question is to discuss what are the causes of the challenges that often arise. The researchers analyze this in hopes of pinpointing the main causes of challenges faced in post-disaster logistics. The third research question is to discuss the methods or solutions that are applied to help solve the problem or challenge. The researchers created the optimal and maximum method so that problems do not occur again. The hope of this research is that the next researcher can be quick to deal with these problems before they arise.

Table 1. The author's analysis based on the type of disaster and the challenges that occur

Type of Disaster	Challenge

Earthquake	• Location
	  ● Distribution
	  ● Routing Problem
	  ● Allocation of Resources
	  ● Procurement
	• Waste Management
	• Financial Funds

Tsunami	• Location
	  ● Facility Location
	  ● Routing Problem
	  ● Distribution
	  ● Coordination
	  ● Procurement
	• Network
	• Waste Management

Storm	• Financial Funds
	• Location
	  ● Distribution
	  ● Coordination
	  ● Allocation of Resources
	• Network

Natural Disasters in General	• Location
	  ● Distribution
	  ● Allocation of Resources
	  ● Coordination
	• Financial Funds
	• Network

Flood	• Location

	● Routing Problem ● Coordination • Financial Funds • Network
Eruption	• Financial Funds • Location ● Allocation of Resources

Based on the Table 1 above, it can be seen that the challenge that often occurs is the challenge of location (allocation to distribute relief goods). Another challenge that often occurs is how to organize the distribution of relief items to those affected by disasters. The literature on humanitarian aid logistics currently focuses mainly on the problem of facility location, management of relief supplies and transportation, this statement was stated by Aghajani, M., & Torabi, SA (2019). According to the type of disaster, earthquakes are a type of disaster that often occurs. This is because earthquakes are natural occurrences that occur suddenly. The standby simulation in the event of an earthquake is also less applicable in each study.

In this study, the main challenge of location is divided into two categories, facility location and location distribution. The study explained that facility location is the lack of available facilities to help or overcome any problems or challenges faced during a disaster. Challenges in location distribution and allocation of resources also explained that there were many problems in the distribution of relief items. The distribution and allocation of aid rations, the waste of resources that were intended to be distributed, the donations that were not always useful and the obstacles in distributing the relief items appeared to be a lack of manpower.

The problem of repair or network design is also often discussed by researchers. The challenge of network design is concerned with the management of relief supplies and transportation. This claim is supported by the problem of unpredictable demand in terms of time, location, type and size, and ineffective coordination due to damage to communication networks and infrastructure. The problem of network repair is to accelerate the process of transportation networks in distributing all disaster relief and supplies of relief items that do not match the demand.

The next challenge is waste management. Waste management is referred to be the collection, transportation, and disposal of scraps or scraps due to the collapse of a disaster. Lack of assistance for disaster management and personnel can lead to economic, environmental and health problems. Waste management also faces the problem of road network accessibility. This refers to the roads that are closed that will need to be opened to regain network connectivity which makes waste disposal easier and saves time.

The next challenge is to maintain confidence/trust in the disaster relief network. This problem or challenge leads to a big impact on the success of the aid. The lack of trust among workers has resulted in many unnecessary losses of life and difficulties for people affected by the disaster to get help quickly.

One of the articles that discusses this problem focuses on the disaster type of earthquakes, hurricanes and tornadoes. This article conducted research on the potential of hybrid air cargo ships. They aim to demonstrate how hybrid cargo airships can be used to improve the logistical response to a rapidly occurring disaster. The researchers carried out their research through the operation of a gene network repair crew scheduling ratio that emerged from hybrid air cargo ships as part of logistics.

Table 2. Analysis of The Causes by Challenging

Challenges	Cause
Location	• Delays • Lack of Resources • Aid Measures
Networks	• Urgent Need • Uncertainties • Damage to Transportation
Financial Funds	• Competition / Conflict

	• Funding Needs • Unfairness
Waste Management	• Remains of Ruins (debris) • Road Accessibility • Damaged Roads

Based on Table 2 the second research question, the authors analyze the causes of the challenges that which each article focuses on. The researchers analyzed these criteria in hopes of pinpointing the root causes of the challenges faced in the topic of post-disaster humanitarian logistics (HL-PD).

As described in the previous section, location challenges have many sub-challenges (distribution/coordination, resource allocation, routing issues, facility location, and procurement). Each of these sub-challenges has similar but different causes. Usually, articles that have challenges related to distribution/coordination are caused by factors such as delays in taking the necessary action and the lack of resources and relief personnel.

Some of these causes are similar to those of resource allocation challenges. The challenge of resource allocation is mainly related to the limited availability of resources. Depending on the situation, sometimes there are situations where there is excess supply in certain locations, while there are severe shortages in other areas, injustice. Not to mention the problem with the quality of the resources, where there are relief supplies that have had some poor-quality items that are close to being unusable. Apart from delays in the allocation of supply, unfair distribution, and availability of resources, there is also the problem of uncertainty.

Routing problems usually have several challenges that are caused due to uncertainty, the number of fatalities, the location of the fatalities, the level of damage to roads, arteries and critical facilities, and the availability of supplies. Uncertainty is one of the main causes of all these main challenges (not just location).

The main cause of facility location challenges is often the damage to existing infrastructure and supply networks. The pre-existing route may become unusable, causing additional restrictions on access to the affected area. This puts additional pressure on the aid network, as it may need to be redesigned and restructured within a very limited time frame, which not only causes facility location challenges but also other challenges as well such as routing issues.

Procurement is a challenge where the main causes are the problems of supplier selection, competition between other aid organizations, and uncertainty. Providing assistance is a challenging issue, especially when data uncertainty is taken into account.

Challenges in aid network design are a frequent problem in post-disaster humanitarian logistics research in natural disasters. As previously explained, networks have an important role in distributing aid more effectively and efficiently.

The underlying causes of the network include the urgent need to design a relief network for beneficiaries, a high level of uncertainty in requests for assistance, and damage to railways, roads and transportation hubs resulting in the limited distribution of aid. An urgent need often occurs during earthquake disasters. This is due to it being an urgent matter and a sudden earthquake raises an urgent need, which leads to humanitarian logistics being overwhelmed to distribute all the necessities to aid recipients.

In designing an aid network, a strategy is needed so that all the goods can be distributed and reach the beneficiaries without waste. The design that is designed must also optimally save time and costs. The cause that often occurs is the damage experienced in transportation centers such as roads, trains, etc. Transportation is very important in distributing all the relief items efficiently. As a result of the damage, this becomes an obstacle for humanitarian logistics. According to the authors' analysis, humanitarian logisticians must find the best alternative route so that all relief goods are still distributed properly.

According to the authors' analysis, the handling of waste is due to the inability to manage the waste disposal properly. Pieces or remains of debris are caused due to disasters where there is waste that disturbs health

conditions, the environment and so on. Roads that are blocked and edges that are clogged are due to waste or debris that is left over from the disaster. The disaster in question is usually caused due to an earthquake. The challenge of road accessibility has been disrupted due to the many road sections being cleaned. The time to clear the roads can be time-consuming (takes a long time), and there will be waiting time for disaster victims before they can be helped while the teams are working on these roadblocks.

Another cause is the inaccessibility of critical locations. This is related to the challenges that occur in road accessibility. Locations that could not be found or accessed hampered aid distribution. Similar to the previous problem, the main cause of financial funds is competition from NGOs (non-governmental organizations) with each other for financial contributions.

The problem with financial funding is that disaster relief is costly, many articles discuss the challenge to minimize costs and relate to procurement challenges that aim to obtain cheap and readily available relief supplies. Apart from the issue of competition, many stakeholders felt that humanitarian assistance was not successful because of a lack of coordination which resulted in the duplication of services.

All the causes of the challenge are generally the same and are related to one another. The main causes of these challenges are found are (1) uncertainty (2) constraints and immobility (3) limited availability of resources (4) humanitarian failures/problems: lack of appropriate responses (5) delays (6) lack of personnel (7) injustice (8) conflict/competition.

Uncertainty is the most common cause experienced to some degree by all challenges. The uncertainty of supply and demand affects every humanitarian logistics post-disaster challenge. This is because humanitarian logistics is the most widely associated topic of relief supplies, and the uncertainty of demand and supply has a major impact on the entire humanitarian logistics process which leads to many problems/issues.

Table 3. Mathematical Model Analysis Based on Challenges

Challenges	Mathematical Model
Location	• MOIRR Model: Multiple Objective Integrated Network Optimization
Networks	• Stochastic Programming
Financial Funds	• Generalized Nash Equilibrium • Optimization Models • Post-Disaster Multi-Objective Two-Stage Transportation Model
Waste Management	• LCA: Life Cycle Assessment • Excel- Based Decision-Support Tool • E-MIP Model • Metaheuristic Approach

Based on the authors' analysis, Table 3 the methods applied to solve the challenges in HL-PD consist mostly of mathematical models. Most of the articles selected focus on the challenge of location. Each article has a unique mathematical model, although some of them are similar, each mathematical model is slightly different from the other.

To overcome the distribution and allocation challenges, the methods that are often times mentioned in the selected article analyzed are (1) Collaborative Aid Network (CAN), (2) Partially Integrated Effort (PIE), (3) goal programming (GP) - based, (4) multiple-objective integrated response and recovery (MOIRR) model, (5) Hazus Model, (6) a mean-variance disaster relief supply chain network model, (7) a nondominated sorting genetic algorithm (NSGA-II), (8) a modified NSGA-II called reference point based non-dominated sorting genetic

algorithm-II (RPB NSGA-II), (9) MIP model and a two-stage hybrid metaheuristic approach, (10) bi-objective Mixed Integer Linear programming (MILP) model, (11) Genetic Algorithm (GA), (12) Mixed Integer Linear Programming model, and (13) Compromise Programming (CP) technique and Lexicographic Optimization Method (LOM).

As for the challenge of facility location, the methods used are as follows: (1) meta-heuristic method, (2) stochastic model, (3) modelled the PP-HSD problem during MIP, (4) robust optimization model, (5) deterministic, and (6) dynamic.

Articles that do not apply a mathematical model are those that challenge the potential of remotely controlled aircraft systems and hybrid cargo airships. Where they do not have a method because the challenge is to demonstrate the potential of a remotely piloted aircraft system or a hybrid cargo airship as a solution to the HL-PD problem/challenge.

MOIRR models which stand for multiple objectives, integrated network optimization is the mathematical model method that is most widely used by the selected article analyzed. The Robust Optimization model is also a mathematical model that is used quite often by articles in order to troubleshoot location-related problems such as facility location and distribution. Meanwhile, the Mathematical Optimization Model: real-time decision support tool is used in articles that focus on areas that have the potential to experience natural disasters.

The method that is frequently applied to solve challenges in this network is the stochastic programming model. In this network design challenge, there is an urgent need to design a disaster relief network and there is uncertainty in the demand for assistance. The problem solving is done using the method stochastic programming model. When described on the urgent need to design a disaster relief network using any method e scenario-based possibility-stochastic programming. In the challenge of uncertainty in requests for relief goods, the method used is a new accessibility metric and developing a two-stage stochastic programming model. Another challenge is that railroads, roads, and transportation centers are damaged which hampers the design of the aid network so that the taboo search algorithm is used. This method is intended to make logical decisions for solving problems in damaged railways, roads and transportation centers.

The challenge in the limited distribution method used is a mixed-integer linear programming (MIP) reformulation for (MICC) with adjustable risk tolerances. Furthermore, to find the best route in the distribution of goods, the method used ArcGIS techniques: a framework based on Geographic Information System (GIS). This geographic information system (GIS) is one of the methods in solving the problem of a phenomenon in the geographic scope. The benefits of this GIS can help find the best path based on geographical conditions.

The methods used to solve these challenges to waste management are varied. In the challenge that disaster waste cannot be managed with standard disposal options, the method used is the Life cycle assessment (LCA). This method is intended to compare waste management scenarios in several cities.

The pieces of debris resulting from the disaster are also a challenge for researchers because the remains are considered to be detrimental and damage to health, the environment and human resources affected by the disaster. In this challenge, the Excel-based decision-support tool: mathematical model is used. In this method, the objective is to assist in decision-making to manage the collection of remaining debris and disposal operations.

The next challenge is the blocked roads and clogged edges that have to be fixed by the workers. So we need the method of Lexicographic classification heuristic, ranking heuristic, and savings heuristic. The time to clear certain roads may take a long time, and victims will wait to connect with assistance when the team working on the road becomes a challenge, in this case, used E-MIP Model. As for the challenge when inaccessibility of the location researchers uses methods metaheuristic approach.

Although there are not many articles that focus on the challenges of financial finance, each article that addresses this challenge has a different method. The methods are (1) Generalized Nash Equilibrium (GNE) model, (2) optimization models: for three alert levels, (alert phase, danger phase and post-disaster phase), and (3) post-disaster multi-objective two-stage transportation model: global criteria method using the Lingo 13.0 optimizer

solver and genetic algorithm. There are also articles aimed at cost-effectiveness to provide assistance through information technology, monitoring, transparency, security, and communication.

Overall, the methods used to solve the challenges in HL-PD are mathematical models that are uniquely generated based on each problem/challenge that is focused on by the articles. Although almost all articles produce mathematical models for solving focus challenges, some articles do not require a mathematical model to solve the challenges. These articles are those whose topic proposes solutions to focus on as their main challenge (e.g., hybrid cargo drones).

4. Conclusion

Based on the research articles selected to be analyzed to answer the 3 research questions (challenges, causes, and methods), it can be concluded that the challenges that hinder humanitarian logistics after natural disasters consist of 4 main challenges, namely (1) location, (2) waste management, (3) networks and (4) financial funds. The challenges most often faced in the topic of HL-PD in natural disasters are location, which is divided into sub-challenges: allocation or distribution, other potential solutions (eg. drones), location of facilities, route problems, and procurement. Causes of challenges hindering the post-disaster humanitarian logistics process are (1) uncertainty, (2) constraints and immobility, (3) limited availability of resources, (4) failure of humanitarian issues: lack of appropriate responses, (5) time delays, (6) lack of personnel, (7) injustice, and (8) conflict/competition. The methods applied to help solve problems that occur after natural disasters mostly use mathematical modelling methods. However, the authors also found that there are certain articles that don't use mathematical modelling (an example is a research article that focuses on a potential solution in drones).

The authors' suggestion for future research prospects is to focus on a natural disaster. This is because this study found that there are currently too many articles that discuss and focuses on earthquakes and natural disasters in general, while there are still many examples of other natural disasters, such as landslides, drought, abrasion (coastal erosion) and so on, and their application to further develop in using mathematical modelling methods to solve problems. Then it can be seen based on the causes of the research, which are network problems, waste management, financial funds, and location distribution, that businesses should avoid the main causes that incite these problems so that they can handle and resolve them more quickly and effectively to help victims of natural disasters. By doing this, businesses can identify the causes of disasters that must be avoided and produce good and quality handling in humanitarian logistics when helping victims of natural disasters.

References

Albliwi, S., Antony, J. and Lim, S. A. H., A systematic review of lean six sigma for the manufacturing industry, *Business Process Management Journal*, 21: 3, pp. 665–91, 2015.

Aghajani, M., & Torabi, S. A., A mixed procurement model for humanitarian relief chains. *Journal of Humanitarian Logistics and Supply Chain Management, 10*(1), 45-74, 2019.

Banomyong, R., Varadejsatitwong, P., & Oloruntoba, R., A systematic review of humanitarian operations, humanitarian logistics and humanitarian supply chain performance literature 2005 to 2016. *Annals of Operations Research*, *283*(1-2), 71-86, 2019.

Bhimani, H., Mention, A. L, & Barlatier, P. J., social media and innovation: A systematic literature review and future research directions. *Technological Forecasting and Social Change*, *144*, 251-269, 2019.

Boonmee, C., Arimura, M., & Asada, T., Facility location optimization model for emergency humanitarian logistics. *International Journal of Disaster Risk Reduction*, *24*, 485-498, 2017.

Cozzolino, A., Wankowicz, E., & Massaroni, E., Logistics service providers' engagement in disaster relief initiatives. *International Journal of Quality and Service Sciences*, 9 (2/4), 269-291, 2017.

Durach, C. F., Kembro, J., & Wieland, A., A new paradigm for systematic literature reviews in supply chain management. *Journal of Supply Chain Management*, *53*(4), 67-85, 2017.

Harrison, S. E, & Johnson, P.A., Crowdsourcing the disaster management cycle. *International Journal of Information Systems for Crisis Response and Management* (IJISCRAM), 8(4), 17-40, 2016.

Montoya, F. G., Alcayde, A., Baños, R., & Manzano-Agugliaro, F., A fast method for identifying worldwide scientific collaborations using the Scopus database. *Telematics and Informatics, 35*(1), 168–185, 2018.

Ransikarbum, K., & Mason, S. J.,Multiple-objective analysis of integrated relief supply and network restoration in humanitarian logistics operations. *International Journal of Production Research*, *54*(1), 49-68, 2016.

Rizzo, G., Tomassetti, F., Vetro, A., Ardito, L., Torchiano, M., Morisio, M., & Troncy, R., Semantic enrichment for recommendation of primary studies in a systematic literature review. *Digital Scholarship in the Humanities*, 32(1), 195-208, 2017.

Tofighi, S., Torabi, SA, & Mansouri, SA., Humanitarian logistics network design under mixed uncertainty. *European Journal of Operational Research*, *250*(1), 239-250, 2016.
Vicente-Saez, R., & Martinez-Fuentes, C., *Open Science now: A systematic literature review for an integrated definition. Journal of Business Research, 88, 428–436*, 2018.
Xu, J., Wang, Z., Shen, F., Ouyang, C., & Tu, Y., Natural disasters and social conflict: a systematic literature review. *International Journal of Disaster Risk Reduction*, 17, 38-48, 2016.

Biographies

Sambudi Hamali is a lecturer in Management Department at Binus University since 2014. He is graduated with Doctoral Degree in Management Science from Padjadjaran University. He has experience in various industries, not only in education but also in the construction and services industry.

Helen Purnama Hutahaean is graduated from Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University.

Kezia Audrey Widjaja is graduated from Management Department, BINUS Business School Undergraduate Program, Bina Nusantara University.