Parion Akademik Bakış Dergisi (PABD)
Parion Academic Review Journal (PARJ)
Cilt/Volume 2, Sayı/No 2, ss.pp.: 18-34

SIMULATION APPLICATIONS IN DISASTER MANAGEMENT: A SYSTEMATIC REVIEW FOR SUPPLY CHAIN MANAGEMENT AND LOGISTICS

Çağdaş ATEŞ[1]

Abstract

Disasters have severe damage to social life and economies, especially human losses. In order to prevent these losses and damages, disaster management is highly critical. Operations such as facility location selection, stock pre-positioning, disaster mitigation, and supplying products and services to the disaster area in disaster management, which generally has two stages, pre-disaster and post-disaster, are considered supply chain management and logistics operations. In this context, publications using various simulation techniques have emerged to improve these operations. Therefore, this research aims to present simulation studies related to supply chain management and logistics activities in disaster management through a systematic literature review. As a result of the search made on the SCOPUS database within the scope of the research carried out to achieve the aim, 82 studies were found in the first stage. Only journal articles and conference proceedings were considered among these studies, and irrelevant studies were excluded by examining these publications in detail. Afterward, citation and co-occurrence analyzes were performed for these 56 publications. Finally, the publications using simulation techniques such as monte carlo, system dynamics, agent-based and discrete event used in these publications were analyzed. In addition, it has been tried to reveal which subjects are emphasized in the studies carried out according to simulation techniques.

Keywords: Disaster Management, Simulation, Supply Chain Management, Logistics, Simulation Techniques.

[1] Ph.D. Student in Transportation and Logistics, Institute of Social Sciences, Istanbul University, Turkiye, cagdasates@ogr.iu.edu.tr, 0000-0002-2590-1935

1. Background

Disasters are human-made or naturally occurring events that affect many people. It is very difficult to predict or control natural disasters in particular. These disasters cause many deaths, homelessness, and national economic and social losses (Salam and Khan, 2020). As seen in Table 1, an average of 406 natural disasters occur each year and 46 thousand people die in natural disasters. In addition, there is an economic loss of approximately 319 billion USD globally. For 2021, a total of 401 natural disasters were reported worldwide, and approximately 10,000 people died in these disasters. In addition, approximately 343 billion US dollars of economic losses occurred worldwide due to these natural disasters (Statista, 2022).

Table 1. Number of natural disasters, Number of deaths, and Economic losses from 2007 to 2021

Year	*No. of Natural Disasters*	*No. of Deaths*	*Economic Losses*
2007	383	~ 20.000	186 bilion USD
2008	437	~ 240.000	397 bilion USD
2009	391	~ 14.000	194 bilion USD
2010	429	~ 236.000	380 bilion USD
2011	362	~ 51.000	615 bilion USD
2012	373	~ 12.000	318 bilion USD
2013	388	~ 23.000	270 bilion USD
2014	407	~ 10.000	196 bilion USD
2015	398	~ 25.000	191 bilion USD
2016	400	~ 9.000	297 bilion USD
2017	431	~ 13.000	532 bilion USD
2018	433	~ 10.000	308 bilion USD
2019	440	~ 11.000	265 bilion USD
2020	430	~ 8.000	297 bilion USD
2021	401	~ 10.000	343 bilion USD

Source: Statista

Disaster management becomes a significant topic considering disasters' human, economic and social losses. Disaster management is generally a two-stage process pre-disaster preparation and post-disaster response and recovery (Giedelmann-L et al., 2022). The pre-disaster preparedness stage includes strategic decisions such as facility location selection, stock pre-positioning, and disaster mitigation plans before the disaster (Caunhye et al., 2012). Post-disaster stage refers to removing disaster victims from the disaster area after the disaster and supplying products and services to the disaster area depending on the needs and demands (Wang & Zhang, 2019). As a result, in both stages, logistics and supply chain management activities are critical to improving disaster management performance (Oloruntoba et al., 2018). For this reason, many studies on supply chain management and logistics are in the disaster management literature. Some of these studies solve logistics and supply chain problems in disaster management with optimization techniques based on mathematical formulation (Chong et al., 2019; Saffarian et al., 2015; Maharjan & Hanaoka, 2018; Condeixa et al., 2017; Mete & Zabinsky, 2010) and some others are studies based on simulation techniques such as monte carlo, agent-based, system dynamics and discrete event.

This research aims to present simulation studies related to supply chain management and logistics activities in disaster management through a systematic literature review. This research seeks answers to the following questions;

1- How many simulation studies have been conducted in disaster management related to logistics and supply chain from 2008 to 2022, and what is the distribution of simulation studies in disaster management related to logistics and supply chain according to authors, journals and countries?

2- What are the concepts addressed in simulation studies in disaster management related to logistics and supply chain?

3- Which of the four simulation techniques (monte carlo, agent-based, system dynamics, discrete event) were used more in the simulation studies in the field of disaster management related to logistics and supply chain?

In the second section, the methodology section will include information about the research process, the research techniques used, and the analysis method. The third section will mention the findings obtained as a result of the analysis. Finally, a discussion and conclusions will be given in the fourth section.

2. Methodology

This study conducted a systematic literature review of supply chain management and logistics-based simulation studies in the disaster management field. The studies to be analyzed were taken from the SCOPUS database. In the first stage, as seen in Table 1, the analysis was made with related word groups. As a result, 82 publications were accessed (Figure 1). Next, these publications were filtered, and only journal articles and conference proceedings were taken; review and book chapter studies were excluded from the analysis. Furthermore, considering the languages of the analyzed publications, only English publications were included. Finally, by examining the titles, abstracts and full text of the publications, irrelevant studies were excluded from the scope of the study, and 56 articles were analyzed. VOSviewer software was used to perform the bibliometric analyzes of this study (Van Eck & Waltman, 2010).

Table 2. Search on the SCOPUS database

Steps	Search condition (Publication type: Journal articles and conference proceedings, Timespan: 2008-2022), Language: English	No. of Publications
1	TITLE-ABS-KEY ("disaster") AND TITLE-ABS-KEY ("simulation") AND TITLE-ABS-KEY ("logistics") OR TITLE-ABS-KEY ("supply chain") AND TITLE-ABS-KEY ("monte carlo") OR TITLE-ABS-KEY ("agent-based") OR TITLE-ABS-KEY ("system dynamics") OR TITLE-ABS-KEY ("discrete event") OR TITLE-ABS-KEY ("discrete-event") AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j") OR LIMIT-TO (SRCTYPE , "p"))	**82**
2	Detailed examination of the title, abstract and full texts	**56**

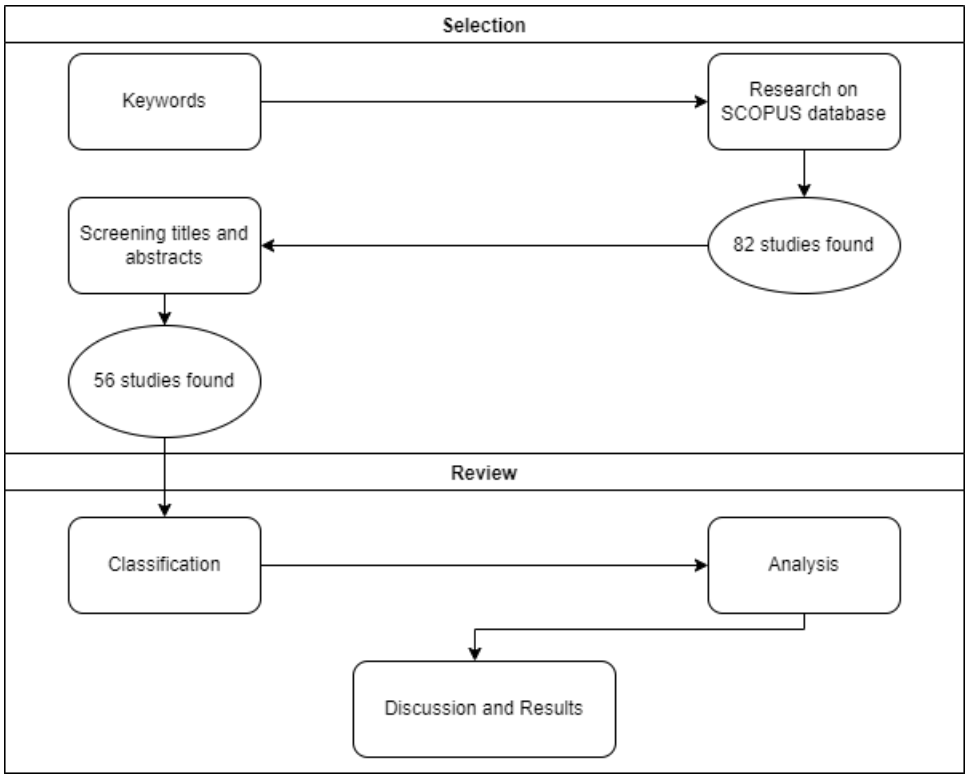

Figure 1. Research Process

3. Findings

3.1. Number of Publications by Years and Citation Analysis

In this section, the distribution and citation analysis of 56 studies, which have been examined in detail and will be used as the study's data, will be given. Citation analysis is a method of analysis in which the ranking of citations about journals, articles in journals, the authors of the articles, and the establishment or country of these authors is given (Martyn, 1975). Citation analysis is frequently used in bibliometrics as a scientific criterion, especially regarding rankings of researchers, journals, and institutions (Ellegaard & Wallin, 2015). In this framework, the number of studies on supply chain management and logistics carried out in disaster management from 2008 to 2022 using simulation techniques is given in Figure 2. Of the 56 studies conducted between these years, 36 were journal articles and 20 were conference proceedings. As seen from the graph, between 2008 and 2011, two conference papers were published regularly every year. As of 2013, journal articles in this field have started to be published in addition to conference proceedings. It is seen that the most publications of the type of conference papers were made in 2017, with three, and the most publications of the type of journal articles were made in 2020 and 2022, with six each. Considering the total number of publications, regardless of the publication type, it is seen that most were made in 2020. Other striking details are that only conference papers were published between 2008 and 2012, and only journal articles were published in 2022.

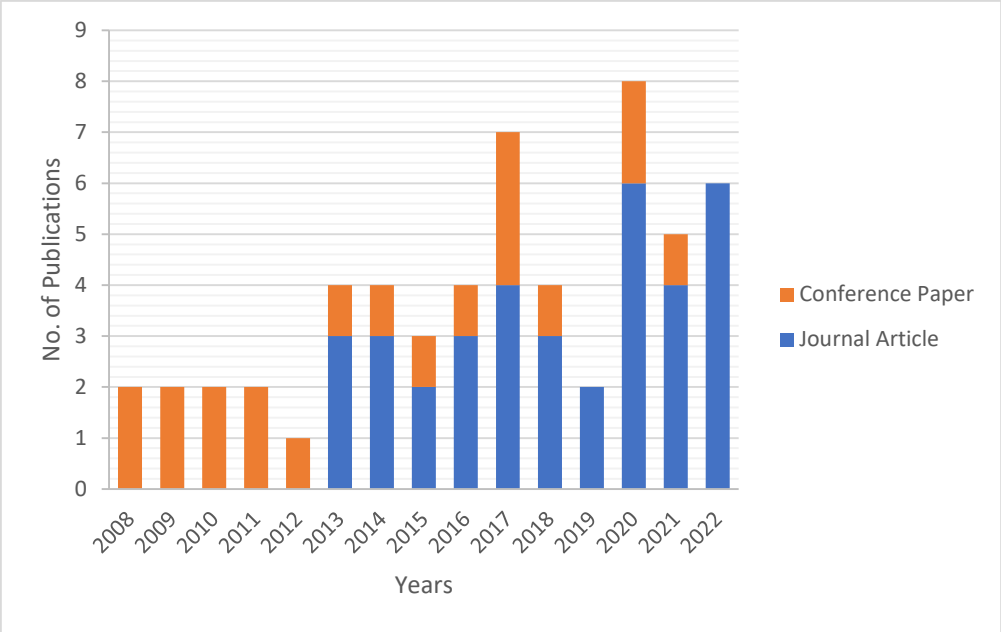

Figure 2. Number of Publications from 2008 to 2022

The results of the citation analysis for authors and sources are given in Table 3. As a result of the studies reviewed, the top six authors with the most citations are Nezih Altay (4.91%), Raktim Pal (4.33%), Armin Jabbarzadeh, Behnam Fahimnia, Jiuh-Biing Sheu and Hani Shahmoradi Moghadam (3.90%). The five most cited journals are Production and Operations Management (13.97%), Transportation Research Part B: Methodological (12.59%), International Journal of Disaster Risk Reduction (10.16%), Computers and Operations Research (9.10%), and Journal of Humanitarian Logistics and Supply Chain Management (7.30%).

Table 3. Citation Analysis for Authors and Sources

Authors	*Citations*	*%*	*Source*	*Citations*	*%*
Nezih Altay	150	4,91%	Production and Operations Management	132	13,97%
Raktim Pal	132	4,33%	Transportation Research Part B: Methodological	119	12,59%
Behnam Fahimnia	119	3,90%	International Journal of Disaster Risk Reduction	96	10,16%
Armin Jabbarzadeh	119	3,90%	Computers and Operations Research	86	9,10%
Hani Shahmoradi Moghadam	119	3,90%	Journal of Humanitarian Logistics and Supply Chain Management	69	7,30%
Jiuh-Biing Sheu	119	3,90%	Nature Sustainability	53	5,61%
Hong Chen	94	3,08%	Expert Systems with Applications	50	5,29%
Min Peng	94	3,08%	Journal of Industrial Engineering International	39	4,13%
Yi Peng	86	2,82%	Journal of Cleaner Production	36	3,81%
Christian Fikar	76	2,49%	Procedia Computer Science	32	3,39%

The results of the citation analysis for countries are given in Table 4. As seen in Table 4, the countries with the most publications are the United States, China, Germany, Singapore, and Austria, respectively. In terms of the number of citations, the ranking is United States (24.06%), China (13.77%), Iran (11.06), Austria (8.28%), and Taiwan (8.28%).

Table 4. Citation Analysis for Countries

Rank	*Country*	*No. of docs*	*Citations*	*%*	*Rank*	*Country*	*No. of docs*	*Citations*	*%*
1	United States	20	346	24,06%	10	United Kingdom	2	37	2,57%
2	China	11	198	13,77%	11	Qatar	1	36	2,50%
3	Iran	3	159	11,06%	12	Canada	3	30	2,09%
4	Australia	1	119	8,28%	13	Colombia	3	17	1,18%
5	Taiwan	1	119	8,28%	14	Italy	1	15	1,04%
6	Singapore	4	96	6,68%	15	France	1	11	0,76%
7	Germany	6	90	6,26%	16	Netherlands	1	11	0,76%
8	Austria	4	83	5,77%	17	Norway	1	11	0,76%
9	Japan	2	59	4,10%	18	India	1	1	0,07%
10	United Kingdom	2	37	2,57%	19	Greece	2	0	0,00%
11	Qatar	1	36	2,50%	20	Indonesia	1	0	0,00%

The top 10 most cited publications are shown in table 5. The top three most cited articles are Information diffusion among agents: implications for humanitarian operations (15.28%), Designing a supply chain resilient to major disruptions and supply/demand interruptions (13.77%), and Modeling and simulating the dynamic environmental environmental factors in post-seismic relief operation (9.95%).

Table 5. The Most Cited Publications

No	*Document*	*Citations*	*%*
1	Information Diffusion Among Agents: Implications for Humanitarian Operations	132	15,28%
2	Designing a supply chain resilient to major disruptions and supply/demand interruptions	119	13,77%
3	Modelling and simulating the dynamic environmental factors in post-seismic relief operation	86	9,95%
4	Framework for improving the resilience and recovery of transportation networks under geohazard risks	61	7,06%
5	Firm-level propagation of shocks through supply-chain networks	53	6,13%
6	Agent-based simulation optimization for dynamic disaster relief distribution	50	5,79%
7	A robust optimization model for distribution and evacuation in the disaster response phase	39	4,51%
8	Sustainable food security decision-making: An agent-based modelling approach	36	4,17%

9	Enhancement of supply chain resilience through inter-echelon information sharing	29	3,36%
10	Managing volunteer convergence at disaster relief centers	19	2,20%

3.2. Co-occurrence Analysis

The concepts obtained by co-occurrence analysis are given in Figure 3. According to the results of the co-occurrence analysis, it is seen that the most focused topics are humanitarian logistics, system dynamics, and agent-based modeling. Therefore, four simulation techniques, including agent-based and system dynamics simulation techniques, will be presented in 3.3. section.

Humanitarian logistics, one of the critical elements of an effective disaster management process, is a specialized logistics activity that includes managing the supply of products and services within critical time windows in the face of demand fluctuations, uncertainties, and infrastructure gaps (Apte, 2010). Human logistics has become a frequently studied subject, especially in the last decade, so many bibliometric studies and meta-analysis studies have been conducted (Paciarotti et al., 2022; Rojas Trejos et al., 2022; Khan et al., 2022; Hezam & Nayeem, 2020; Kunz & Reiner, 2012). Humanitarian logistics activities use logistics science in emergency and relief provision to mitigate the effects of man-made or natural disasters. Since natural disasters are highly affected by uncertainty, humanitarian logistics issues are discussed with simulation approaches in order to eliminate this uncertainty (D'Uffizi et al. 2015).

In one of the studies carried out within the scope of humanitarian logistics, Fikar et al. (2016) proposed a decision support system based on simulation and optimization to ensure disaster relief coordination between private and public relief organizations. An agent-based simulation was applied in the simulation part of the study. In another study, Lau et al. (2012) provided the coordination of the distribution of resources in post-disaster response using an agent-based simulation technique. Suárez-Moreno et al. (2016) demonstrated the effect of actors and their relations on logistics performance in relief flows within humanitarian logistics using an agent-based simulation technique.

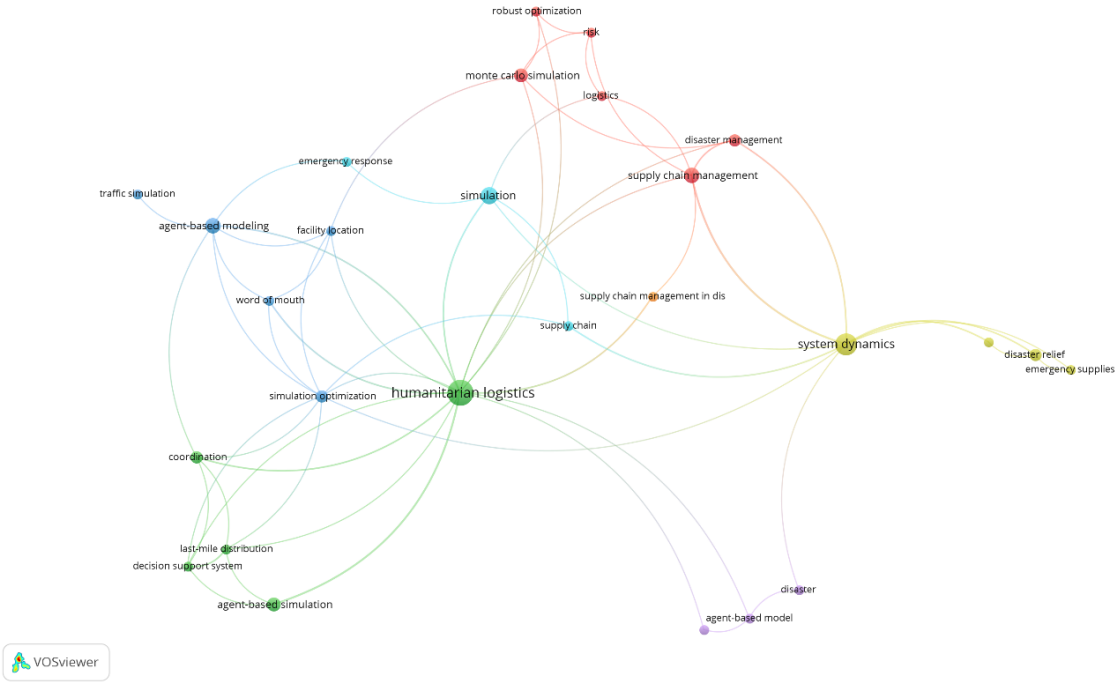

Figure 3. Concepts Network

3.3. Literature According to Simulation Techniques

In disaster management, publications with simulation content on logistics and supply chain management are classified in Table 6 according to simulation techniques. When the related table is examined, it is seen that the agent-based simulation technique (32%) has the highest number of studies, with 18 studies. Secondly, the highest number of studies was system dynamics (29%) with 16 studies, monte carlo (26%) with 13 studies, and discrete event (16%) with nine studies.

Table 6. Publications Based on Simulation Technique

Types of Simulation	*Conferance Papers*	*Articles*	*Total Publications*	*%*
Agent-based	Lau et al. (2012), Mustapha et al. (2013), Lee et al. (2017), Ottenburger & Bai (2017), Seipp et al. (2018), Gude et al. (2020).	Ehlen et al. (2014), Altay & Pal (2014), Fikar et al. (2016), Suárez-Moreno et al. (2016), Aros & Gibbons (2018), Fikar et al. (2018), Wang & Zhang (2019), Inoue & Yodo (2019), Abualkhair et al. (2020), Namany et al. (2020), Dulam et al. (2021), Espejo-Díaz & Guerrero (2021).	18	32%
Discrete Event	Noreña et al. (2011), D'Uffizi et al. (2015), Chen et al. (2017), Cherkesly et al. (2020),	Cohen et al. (2013), Timperio et al. (2020), Kogler & Rauch (2020), Oliver et al. (2022), K.K.K et al. (2022),	9	16%

Monte Carlo	Chandra-Sekaran et al. (2009a), Chandra-Sekaran (2009b), Jin et al. (2010), Jamshidieini & Rezaie (2016).	Green et al. (2013), Jabbarzadeh et al. (2016), Tong et al. (2017), Fereiduni & Shahanaghi (2017), Aydin et al. (2018), Baharmand et al. (2020), Ataseven et al. (2020), Shirley et al. (2021), Diaz et al. (2022).	13	23%
System Dynamics	Yang (2008), Lant et al. (2008), Wang & Huang (2010), Ming & Hong (2011), Amundson et al. (2014), Lu et al. (2021).	Peng et al. (2013), Peng et al. (2014), Diedrichs et al. (2015), Özpolat et al. (2015), Mansur et al. (2017), Li et al. (2017), Qiu et al. (2021), Xu et al. (2022), Katsoras & Georgiadis (2022a), Katsoras & Georgiadis (2022b).	16	29%
SUM	**20**	**36**	**56**	**100%**

3.3.1. System Dynamics

System dynamics, one of the frequently used simulation models, is an advantageous simulation technique in describing systems with high uncertainty (Peng et al., 2013) and structural complexity (Peng et al., 2014). With system dynamics, problems can be modeled as a system, and solutions can be developed from different perspectives (Mansur et al., 2017). In studies on system dynamics, disruptions in the supply chain are discussed by considering different types of disasters. For example, Peng et al. (2013) discussed managing risks in the post-seismic supply chain in their study. This study, which focuses on the problem of interruption of the humanitarian relief supply chain caused by the uncertainty and incomplete information after the earthquake, it is aimed to simulate the road network and delayed information. As a result of the simulation, stock and logistics planning strategies were suggested for the post-earthquake decision-makers. In another study dealing with the flood disaster, Mansur et al. (2017) discussed logistics procurement regulations to reduce the impact of flood disasters on the supply chain of medicine. In another study by Min & Hong (2011), the problem of transportation and information delay in disaster relief operations was discussed. In this study, which aims to find out how transportation and information delay affect the material flow and information flow, it is concluded that the delay in transportation directly affects the material flow. In contrast, the information delay affects the system in various ways.

3.3.2. Monte Carlo

Monte Carlo simulation is a technique that generally uses sampling and statistical modeling to predict mathematical functions and emulate complex systems (Harrison et al., 2010). This simulation technique, which researchers in disaster management prefer, is generally used to provide input to models. For example, Green et al. (2013) researched waste transport in a flood-prone slum area. They sought to determine whether waste transportation would be a high-margin business for private-sector service providers. They applied an analytical modeling technique based on Monte Carlo simulation. In another study, Jamshidieini & Rezaie (2016) used a simulation method to estimate the resilience of these networks, taking into account the damage of natural disasters such as earthquakes, hurricanes, and floods to energy transmission and distribution networks. In this study, in which the Monte Carlo simulation technique was

used, it was revealed by the authors that the technique was flexible and suitable for sensitivity analysis. In another study, Jabbarzadeh et al. (2016) examined the disruptions and supply/demand disruptions created by disasters in global supply chains. In the study, a stochastic optimization model was presented, and a performance analysis was also carried out using the Monte Carlo simulation method. A durable supply chain design is presented in the study, where a real-world case example is also discussed.

3.3.3. Discrete Event

Discrete-event simulation is a technique used to understand the change in real-world systems over time and to compare the system's performance under different conditions (Tako & Robinson, 2012). It is mainly used in matters that require decision-making in production and logistics planning (Lang et al., 2021).). In disaster management, it is used to evaluate logistics operations. For example, Norena et al. (2011) evaluated the logistics of medical intervention in humanitarian aid operations in the Bogota earthquake with the discrete-event simulation technique. In this study, the current emergency operation related to the intervention of the injured in the first four days after the earthquake was evaluated, and the transportation of the injured to temporary and permanent hospitals was simulated. In another study, Timperio et al. (2020) propose an integration of multi-criteria decision-making, network optimization and discrete-event simulation that addresses inventory pre-positioning to improve the efficiency, effectiveness, and agility of relief chains in humanitarian logistics. This study also includes a real-life case study in Indonesia. The related simulation was carried out on AnyLogistix software.

3.3.4. Agent-based

Agent-based simulation, which emerged in the early 1990s (Siebers et al., 2010), can be defined as simulating a system with agents interacting with each other with little or no central direction (Albino et al., 2006). Agent-based models use self-managed agents with a bottom-up approach to simulate assets in a complex system. In particular, it provides the opportunity to investigate a complex system down to the last detail (Jing et al., 2020). The agent-based simulation technique has been frequently used in human logistics-based studies. For example, Lau et al. (2012) proposed an agent-based simulation model for post-disaster response, aiming to automate the coordination of scarce resources and minimize human loss. They solved this problem separately with optimization and simulation techniques and compared their results. In another study, Mustapha et al. (2013) simulated an emergency activity, including organizational structure and policies for post-disaster response, with agent-based simulation modeling. According to Fikar et al. (2016), a decision support system model based on simulation and optimization integration was presented to ensure disaster relief coordination between private and public institutions. Disasters were simulated in the decision support system, and optimization was made for the distribution planning stages. In the study by Altay & Pal (2014), agent-based simulation, which provides a more effective response to disasters by providing better information flow with the correct use of clusters according to the clustering approach,

was revealed. According to the research results, if the cluster leaders act as information centers, they reach the information target faster, so the post-disaster response is faster.

4. Discussion and Conclusions

Whether man-made or natural, disasters cause severe damage to people's health and economic and social life, disaster management is significant in order to prevent these damages, even partially. Therefore, many scientific studies are carried out in disaster management, and all studies have common aims to reduce the adverse effects of disasters. There are generally two stages in disaster management; pre-disaster preparedness and post-disaster response. In both stages, supply chain management and logistics activities are critical in meeting all requests and needs, such as medicine, shelter, and food. However, when the studies in the literature are examined, it is seen that the negativities experienced in the supply chain or logistics in disaster management are due to uncertainties and the need for more information, especially in simulation studies. Therefore, this research aims to present simulation studies related to supply chain management and logistics activities in disaster management through a systematic literature review. As a result of the search made on the SCOPUS database within the scope of the research carried out to achieve the aim, 82 studies were found in the first stage. Only journal articles and conference proceedings were considered among these studies, and irrelevant studies were excluded by examining these publications in detail. Afterward, citation and co-occurrence analyzes were performed for these 56 publications.

As a result of the analyzes made in the study, the most cited articles, the most cited journals, countries, and the most cited studies are shown in tables according to the citation order. In studies conducted with co-occurrence analysis, it has been seen that the concept of humanitarian logistics and simulation techniques have come to the fore. The studies examined were also classified according to the simulation techniques used. As a result of the classification, it was seen that the agent-based simulation technique was used the most, with a rate of 32% in the studies conducted from 2008 to 2022, and the discrete event simulation technique was used at least with a rate of 16%. It is also seen that different types of disasters are the subject of studies in studies conducted with simulation techniques.

In this study, the literature on disaster management studies in which simulation techniques are used in the context of logistics and supply chain has been tried to be explained. For this reason, this study can benefit researchers working in this field and policymakers regarding disaster management in the public or private sector. The publications analyzed in the study were taken from the SCOPUS database, and publications in other databases, such as Web of Science and EBSCO, can be included in the analysis in future studies. In new research to be made, a current literature study can be carried out by separately evaluating the pre-disaster and post-disaster preparations and operations.

References

Abualkhair, H., Lodree, E. J., & Davis, L. B. (2020). Managing volunteer convergence at disaster relief centers. *International Journal of Production Economics*, 220, 107399. https://doi.org/10.1016/j.ijpe.2019.05.018

Albino, V., Carbonara, N., & Giannoccaro, I. (2006). Innovation in industrial districts: An agent-based simulation model. *International Journal of Production Economics*, 104(1), 30-45. https://doi.org/10.1016/j.ijpe.2004.12.023

Altay, N., & Pal, R. (2014). Information diffusion among agents: Implications for humanitarian operations. *Production and Operations Management*, 23(6), 1015-1027. https://doi.org/10.1111/poms.12102

Amundson, J., Brown, A., Grabowski, M., & Badurdeen, F. (2014). Life-cycle risk modeling: Alternate methods using bayesian belief networks. *Procedia CIRP*, 17, 320-325. https://doi.org/10.1016/j.procir.2014.02.029

Apte, A. (2010). Humanitarian logistics: A new field of research and action. *Foundations and Trends in Technology, Information and Operations Management*, 3(1), 1-100. https://doi.org/10.1561/0200000014

Aros, S. K., & Gibbons, D. E. (2018). Exploring communication media options in an inter-organizational disaster response coordination network using agent-based simulation. *European Journal of Operational Research*, 269(2), 451-465. https://doi.org/10.1016/j.ejor.2018.02.013

Ataseven, C., Nair, A. and Ferguson, M. (2020), "The role of supply chain integration in strengthening the performance of not-for-profit organizations: evidence from the food banking industry", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 10 No. 2, pp. 101-123. https://doi.org/10.1108/JHLSCM-04-2019-0024

Aydin, N. Y., Duzgun, H. S., Heinimann, H. R., Wenzel, F., & Gnyawali, K. R. (2018). Framework for improving the resilience and recovery of transportation networks under geohazard risks. *International Journal of Disaster Risk Reduction*, 31, 832-843. https://doi.org/10.1016/j.ijdrr.2018.07.022

Baharmand, H., Comes, T., & Lauras, M. (2020). Supporting group decision makers to locate temporary relief distribution centres after sudden-onset disasters: A case study of the 2015 Nepal earthquake. *International Journal of Disaster Risk Reduction*, 45, 101455. https://doi.org/10.1016/j.ijdrr.2019.101455

Caunhye, A. M., Nie, X., & Pokharel, S. (2012). Optimization models in emergency logistics: A literature review. *Socio-Economic Planning Sciences*, 46(1), 4-13. https://doi.org/10.1016/j.seps.2011.04.004

Chandra-Sekaran, A.K., Stefansson, G., Kunze, C., Müller-Glaser, K.D., & Weisser, P. (2009). A Range-Based Monte Carlo Patient Localization during Emergency Response to Crisis. *Fifth Advanced International Conference on Telecommunications*. https://doi.org/10.1109/AICT.2009.10

Chandra-Sekaran, A.K., Weisser, P., Müller-Glaser, K.D., & Kunze, C. (2009). A Comparison of Bayesian Filter Based Approaches for Patient Localization during Emergency Response to Crisis. *Third International Conference on Sensor Technologies and Applications*. https://doi.org/10.1109/SENSORCOMM.2009.104

Chen, Y., Ponsignon, T., Weixlgartner, R., & Ehm, H. (2017). Simulating recovery strategies to enhance the resilience of a semiconductor supply network. *2017 Winter Simulation Conference (WSC),* 4477-4478. https://doi.org/10.1109/WSC.2017.8248170

Cherkesly, M., & Maïzi, Y. (2020). A simulation model for short and long term humanitarian supply chain operations management. *2020 Winter Simulation Conference (WSC)*, 1360-1371. https://doi.org/10.1109/WSC48552.2020.9384003

Chong, M., Lazo Lazo, J. G., Pereda, M. C., & Machuca De Pina, J. M. (2019). Goal programming optimization model under uncertainty and the critical areas characterization

in humanitarian logistics management. *Journal of Humanitarian Logistics and Supply Chain Management*, 9(1), 82-107. https://doi.org/10.1108/JHLSCM-04-2018-0027

Cohen, J., Quilenderino, J., Bubulka, J., & Paulo, E. P. (2013). Linking a throughput simulation to a systems dynamics simulation to assess the utility of a US Navy foreign humanitarian aid mission. *Defense & Security Analysis*, 29(2), 141-155. https://doi.org/10.1080/14751798.2013.787795

Condeixa, L. D., Leiras, A., Oliveira, F., & de Brito, I. (2017). Disaster relief supply pre-positioning optimization: A risk analysis via shortage mitigation. *International Journal of Disaster Risk Reduction*, 25, 238-247. https://doi.org/10.1016/j.ijdrr.2017.09.007

Diaz, R., Behr, J. G., & Acero, B. (2022). Coastal housing recovery in a postdisaster environment: A supply chain perspective. *International Journal of Production Economics*, 247, 108463. https://doi.org/10.1016/j.ijpe.2022.108463

Diedrichs, D.R., Phelps, K. and Isihara, P.A. (2016). Quantifying communication effects in disaster response logistics: A multiple network system dynamics model. *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 6 No. 1, pp. 24-45. https://doi.org/10.1108/JHLSCM-09-2014-0031

D'Uffizi, A., Simonetti, M., Stecca, G., & Confessore, G. (2015). A simulation study of logistics for disaster relief operations. *Procedia CIRP*, 33, 157-162. https://doi.org/10.1016/j.procir.2015.06.029

Dulam, R., Furuta, K., & Kanno, T. (2021). Consumer panic buying: Realizing its consequences and repercussions on the supply chain. *Sustainability*, 13(8), 4370. https://doi.org/10.3390/su13084370

Ehlen, M. A., Sun, A. C., Pepple, M. A., Eidson, E. D., & Jones, B. S. (2014). Chemical supply chain modeling for analysis of homeland security events. *Computers & Chemical Engineering*, 60, 102-111. https://doi.org/10.1016/j.compchemeng.2013.07.014

Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics*, 105(3), 1809-1831. https://doi.org/10.1007/s11192-015-1645-z

Espejo-Díaz, J. A., & Guerrero, W. J. (2021). A multiagent approach to solving the dynamic postdisaster relief distribution problem. *Operations Management Research*, 14(1-2), 177-193. https://doi.org/10.1007/s12063-021-00192-1

Fereiduni, M., & Shahanaghi, K. (2017). A robust optimization model for distribution and evacuation in the disaster response phase. *Journal of Industrial Engineering International*, 13(1), 117-141. https://doi.org/10.1007/s40092-016-0173-7

Fikar, C., Gronalt, M., & Hirsch, P. (2016). A decision support system for coordinated disaster relief distribution. *Expert Systems with Applications*, 57, 104-116. https://doi.org/10.1016/j.eswa.2016.03.039

Fikar, C., Hirsch, P., & Nolz, P. C. (2018). Agent-based simulation optimization for dynamic disaster relief distribution. *Central European Journal of Operations Research*, 26(2), 423-442. https://doi.org/10.1007/s10100-017-0518-3

Giedelmann-L, N., Guerrero, W. J., & Solano-Charris, E. L. (2022). System dynamics approach for food inventory policy assessment in a humanitarian supply chain. *International Journal of Disaster Risk Reduction*, 81, 103286. https://doi.org/10.1016/j.ijdrr.2022.103286

Green, J.L., de Weck, O.L. and Suarez, P. (2013), "Evaluating the economic sustainability of sanitation logistics in Senegal", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 3 No. 1, pp. 7-21. https://doi.org/10.1108/20426741311328484

Gude, V., Corns, S., Dagli, C., & Long, S. (2020). Agent based modeling for flood inundation mapping and rerouting. *Procedia Computer Science*, 168, 170-176. https://doi.org/10.1016/j.procs.2020.02.279

Harrison, R. L., Granja, C., & Leroy, C. (2010). Introduction to monte carlo simulation. 17-21. https://doi.org/10.1063/1.3295638

Hezam, I. M., & Nayeem, M. k. (2020). A systematic literature review on mathematical models of humanitarian logistics. *Symmetry*, 13(1), 11. https://doi.org/10.3390/sym13010011

Inoue, H., & Todo, Y. (2019). Firm-level propagation of shocks through supply-chain networks. *Nature Sustainability*, 2(9), 841-847. https://doi.org/10.1038/s41893-019-0351-x

Jabbarzadeh, A., Fahimnia, B., Sheu, J.-B., & Moghadam, H. S. (2016). Designing a supply chain resilient to major disruptions and supply/demand interruptions. *Transportation Research Part B: Methodological*, 94, 121-149. https://doi.org/10.1016/j.trb.2016.09.004

Jamshidieini, B., & Rezaie, K. (2016). Estimating resiliency of energy distribution supply chain by Monte Carlo simulation. *CIRED Workshop 2016*, 156 (4) https://doi.org/10.1049/cp.2016.0756

Jin, S., Zhuang, J., & Liu, Z. (2010). Monte Carlo simulation-based supply chain disruption management for wargames. *Proceedings of the 2010 Winter Simulation Conference*. https://doi.org/10.1109/WSC.2010.5678964

Jing, P., Hu, H., Zhan, F., Chen, Y., & Shi, Y. (2020). Agent-based simulation of autonomous vehicles: A systematic literature review. IEEE Access, 8, 79089-79103.

Katsoras, E., & Georgiadis, P. (2022). A dynamic analysis for mitigating disaster effects in closed loop supply chains. *Sustainability*, 14(9), 4948. https://doi.org/10.3390/su14094948

Katsoras, E., & Georgiadis, P. (2022). An integrated system dynamics model for closed loop supply chains under disaster effects: The case of covid-19. *International Journal of Production Economics*, 253, 108593. https://doi.org/10.1016/j.ijpe.2022.108593

K.E.K, V., Nadeem, S. P., Ravichandran, M., Ethirajan, M., & Kandasamy, J. (2022). Resilience strategies to recover from the cascading ripple effect in a copper supply chain through project management. *Operations Management Research*, 15(1-2), 440-460. https://doi.org/10.1007/s12063-021-00231-x

Khan, M., Parvaiz, G. S., Tohirovich Dedahanov, A., Iqbal, M., & Junghan, B. (2022). Research trends in humanitarian logistics and sustainable development: A bibliometric analysis. *Cogent Business & Management*, 9(1), 2143071. https://doi.org/10.1080/23311975.2022.2143071

Kogler, C., & Rauch, P. (2020). Contingency plans for the wood supply chain based on bottleneck and queuing time analyses of a discrete event simulation. *Forests*, 11(4), 396. https://doi.org/10.3390/f11040396

Kunz, N., & Reiner, G. (2012). A meta-analysis of humanitarian logistics research. *Journal of Humanitarian Logistics and Supply Chain Management*, 2(2), 116-147. https://doi.org/10.1108/20426741211260723

Lang, S., Reggelin, T., Müller, M., & Nahhas, A. (2021). Open-source discrete-event simulation software for applications in production and logistics: An alternative to commercial tools? *Procedia Computer Science*, 180, 978-987. https://doi.org/10.1016/j.procs.2021.01.349

Lant, T., Jehn, M., Christensen, C., Araz, O. M., & Fowler, J. W. (2008). Simulating pandemic influenza preparedness plans for a public university: A hierarchical system dynamics approach. *Proceedings of the 40th Conference on Winter Simulation*, 1305-1313.

Lau, H. C., Li, Z., Du, X., Jiang, H., & De Souza, R. (2012). Logistics orchestration modeling and evaluation for humanitarian relief. *Proceedings of 2012 IEEE International Conference on Service Operations and Logistics, and Informatics*, 25-30. https://doi.org/https://doi.org/10.1109/SOLI.2012.6273499

Lee, E. K., Pietz, F. H., Chen, C.-H., & Liu, Y. (2017). An interactive web-based decision support system for mass dispensing, emergency preparedness, and biosurveillance. *Proceedings of the 2017 International Conference on Digital Health*, 137-146. https://doi.org/10.1145/3079452.3079473

Li, H., Pedrielli, G., Lee, L. H., & Chew, E. P. (2017). Enhancement of supply chain resilience through inter-echelon information sharing. *Flexible Services and Manufacturing*, 29(2), 260-285.

Lu, J., Zhang, Q., & Fan, W. (2021). Comparison research on different mitigation strategies of supply chain under supply disruption scenarios. *Journal of Physics: Conference Series*, 1744(4), 042157. https://doi.org/10.1088/1742-6596/1744/4/042157

Maharjan, R., & Hanaoka, S. (2018). A multi-actor multi-objective optimization approach for locating temporary logistics hubs during disaster response. *Journal of Humanitarian Logistics and Supply Chain Management*, 8(1), 2-21. https://doi.org/10.1108/JHLSCM-08-2017-0040

Mansur, A., Istianah, S., Kurniawan, W., Albab, M. U., & Suryoputro, M. R. (2017). Logistics Procurement Planning of Medicine to Mitigate Flood Disaster Impact. *Journal of Engineering and Applied Sciences*, 12(3), 6426-6433. http://dx.doi.org/10.36478/jeasci.2017.6426.6433

Martyn, J. (1975), Citation Analysis, *Journal of Documentation*, Vol. 31 No. 4, pp. 290-297. https://doi.org/10.1108/eb026610

Min, P., & Hong, C. (2011). System dynamics analysis for the impact of dynamic transport and information delay to disaster relief supplies. *International Conference on Management Science & Engineering 18th Annual Conference Proceedings*. https://doi.org/10.1109/ICMSE.2011.6069948

Mustapha, K., Mcheick, H., & Mellouli, S. (2013). Modeling and simulation agent-based of natural disaster complex systems. *Procedia Computer Science*, 21, 148-155. https://doi.org/10.1016/j.procs.2013.09.021

Namany, S., Govindan, R., Alfagih, L., McKay, G., & Al-Ansari, T. (2020). Sustainable food security decision-making: An agent-based modelling approach. *Journal of Cleaner Production*, 255, 120296. https://doi.org/10.1016/j.jclepro.2020.120296

Noreña, D., Yamín, L., Akhavan-Tabatabaei, R., & Ospina, W. (2011). Using discrete event simulation to evaluate the logistics of medical attention during the relief operations in an earthquake in Bogota. *In Proceedings of the Winter Simulation Conference* (pp. 2666–2678).

Oliver, E., Mazzuchi, T., & Sarkani, S. (2022). A resilience systemic model for assessing critical supply chain disruptions. *Systems Engineering*, 25(5), 510-533. https://doi.org/10.1002/sys.21633

Oloruntoba, R., Sridharan, R., & Davison, G. (2018). A proposed framework of key activities and processes in the preparedness and recovery phases of disaster management. *Disasters*, 42(3), 541-570. https://doi.org/10.1111/disa.12268

Ottenburger, S., & Bai, S. (2017). Simulation based strategic decision making in humanitarian supply chain management. *4th International Conference on Information and Communication Technologies for Disaster Management (ICT-DM)*, 1-7. https://doi.org/10.1109/ICT-DM.2017.8275683

Özpolat, K., Rilling, J., Altay, N. and Chavez, E. (2015), "Engaging donors in smart compassion: USAID CIDI's Greatest Good Donation Calculator", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 5 No. 1, pp. 95-112. https://doi.org/10.1108/JHLSCM-11-2013-0041

Paciarotti, C., Piotrowicz, W.D. and Fenton, G. (2021), "Humanitarian logistics and supply chain standards. Literature review and view from practice", *Journal of Humanitarian*

Logistics and Supply Chain Management, Vol. 11 No. 3, pp. 550-573. https://doi.org/10.1108/JHLSCM-11-2020-0101

Peng, M., Chen, H., & Zhou, M. (2014). Modelling and simulating the dynamic environmental factors in post-seismic relief operation. *Journal of Simulation*, 8(2), 164-178. https://doi.org/10.1057/jos.2013.27

Peng, M., Peng, Y., & Chen, H. (2014). Post-seismic supply chain risk management: A system dynamics disruption analysis approach for inventory and logistics planning. *Computers & Operations Research*, 42, 14-24. https://doi.org/10.1016/j.cor.2013.03.003

Qiu, Y., Shi, M., Zhao, X., & Jing, Y. (2021). System dynamics mechanism of cross-regional collaborative dispatch of emergency supplies based on multi-agent game. *Complex & Intelligent Systems*. https://doi.org/10.1007/s40747-021-00303-2

Rojas Trejos, C. A., Meisel, J. D., & Adarme Jaimes, W. (2022). Humanitarian aid distribution logistics with accessibility constraints: A systematic literature review. *Journal of Humanitarian Logistics and Supply Chain Management*. https://doi.org/10.1108/JHLSCM-05-2021-0041

Saffarian, M., Barzinpour, F., & Eghbali, M. A. (2015). A robust programming approach to bi-objective optimization model in the disaster relief logistics response phase. *International Journal of Supply and Operations Management*, 2(1), 595-616. https://doi.org/10.22034/2015.1.04

Salam, M. A., & Khan, S. A. (2020). Lessons from the humanitarian disaster logistics management: A case study of the earthquake in Haiti. *Benchmarking: An International Journal,* 27(4), 1455-1473. https://doi.org/10.1108/BIJ-04-2019-0165

Seipp, B., Budhraja, K., & Oates, T. (2018). Optimizing transitions between abstract abm demonstrations. *2018 IEEE 12th International Conference on Self-Adaptive and Self-Organizing Systems (SASO),* 100-109. https://doi.org/10.1109/SASO.2018.00021

Shirley, T., Padmanabha, B., Murray-Tuite, P., Huynh, N., Comert, G., & Shen, J. (2021). Exploring the potential of using privately-owned, self-driving autonomous vehicles for evacuation assistance. *Journal of Advanced Transportation*, 2021, e2156964. https://doi.org/10.1155/2021/2156964

Siebers, P. O., Macal, C. M., Garnett, J., Buxton, D., & Pidd, M. (2010). Discrete-event simulation is dead, long live agent-based simulation! Journal of Simulation, 4(3), 204-210. https://doi.org/10.1057/jos.2010.14

Statista, the statistics portal, Retrieved November 7, 2022, Annual number of natural disaster events globally from 2007 to 2021, by continent and type: https://www.statista.com/statistics/510959/number-of-natural-disasters-events-globally/

Suárez-Moreno, J. D., Osorio-Ramírez, C., & Adarme-Jaimes, W. (2016). Agent-based model for material convergence in humanitarian logistics. *Revista Facultad de Ingeniería Universidad de Antioquia*, 81, 24-34. https://doi.org/10.17533/udea.redin.n81a03

Tako, A.A., Robinson, S. (2012). The application of discrete event simulation and system dynamics in the logistics and supply chain context. *Decisions Support Systems*, 52 (4), 802–815.

Timperio, G., Tiwari, S., Lee, C. K., Samvedi, A., & de Souza, R. (2020). Integrated decision support framework for enhancing disaster preparedness: A pilot application in Indonesia. *International Journal of Disaster Risk Reduction*, 51, 101773. https://doi.org/10.1016/j.ijdrr.2020.101773

Tong, Z., Zhang, Q., Zhu, J., Liu, X., & Yan, F. (2017). A stochastic distribution center location model for earthquake relief supplies based on monte carlo simulation. *The Open Cybernetics & Systemics Journal*, 11(1). https://doi.org/10.2174/1874110X01711010024

Van Eck, N., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics,* 84(2), 523-538.

Wang, X., & Huang, X. (2010). Research on Efficiency of Disaster Supply Chain Based on Collaborative Management. *3rd International Conference on Information Management, Innovation Management and Industrial Engineering*. https://doi.org/10.1109/ICIII.2010.537

Wang, Z., & Zhang, J. (2019). Agent-based evaluation of humanitarian relief goods supply capability. *International Journal of Disaster Risk Reduction*, 36, 101105. https://doi.org/10.1016/j.ijdrr.2019.101105

Xu, Y., Dong, J., Ren, R., Yang, K., & Chen, Z. (2022). The impact of metro-based underground logistics system on city logistics performance under COVID-19 epidemic: A case study of Wuhan, China. *Transport Policy*, 116, 81-95. https://doi.org/10.1016/j.tranpol.2021.10.020

Yang, T. (2008). Financial performance analysis of e-collaboration supply chain under transportation disruptions. *2008 International Symposium on Computer Science and Computational Technology*, 2, 435-439. https://doi.org/10.1109/ISCSCT.2008.372