

## Performance Assessment of Humanitarian Supply Chain using the Gray Approach

**Mohammad Reza Sadeghi Moghadam**\*

Assistant Professor, Faculty of Management, Tehran University, Tehran, Iran,  
rezasadeghi@ut.ac.ir

**Hossein Safari**

Associate Professor, Faculty of Management, Tehran University, Tehran, Iran,  
hsafari@ut.ac.ir

**Reza Barani Beyranvand**

MA, Faculty of Management, Tehran University, Tehran, Iran,  
reza.barani@alumni.ut.ac.ir

**Abstract:** Iran is a country where the rate of natural disasters is high comparing with other countries. Therefore, humanitarian supply chain management before, during and after disasters is of great importance. Performance assess humanitarian supply chain is one of the important activities in humanitarian supply chain management which specifies the performance and how to improve it.

At the beginning, performance dimensions and indicators of the earthquake supply chain in the country were identified. For this purpose, the output of the master's thesis in Tehran University was used and weights of performance dimensions and indicators by normalization factor loadings were obtained. Then, the selected earthquakes were assessed by gray approach. Two scenarios were used to assess reasonably and appropriately. In the first scenario, Just earthquake information was used, but in the second scenario, after setting the standard in qualitative and quantitative indicators, this information is entered in the calculations in the form of a hypothetical earthquake. Results are based on the second scenario which is more complete than the first one. They are: humanitarian supply chain performances in Dashti and Ahar earthquakes were equal and were better than that in Bashagard.

**Keywords:** Humanitarian Supply Chain; Performance Assessment; Grey Approach; Scenario.

**Introduction:** Humanitarian supply chain is a special type of supply chain with unique characteristics which distinguishes it from other market supply chains. Performance of this supply chain has a major role in challenging, controlling, and reducing impacts of disasters (Schulz and Heigh, 2009). Vast losses and casualties in different cities of the world caused by natural disasters have led to extensive applied researches on humanitarian supply chain and rescue logistics management in order to minimize losses encountering a crisis. Among all areas of humanitarian supply chain, performance assessment has a great significance and as matter of fact has been deserted compared to other concepts. Among active organization in humanitarian field, only 45% discussed performance assessment and among them, only 20% are constantly monitoring and also measuring their performance in all activities (Scholten, 2013). Assessing performance of humanitarian supply chain in the past disasters, countries can acquire proper understanding from this supply chain and use information result from this assessment as a feedback to improve supply chain performance in future disasters that inevitably will entangle them. Consequently, this study aims to develop a quantitative approach to assess the performance of humanitarian supply chain in Iran's earthquake disasters.

**Materials and Methods:** In this paper, we used indicators and performance dimensions of a M.A thesis titled as "assessing performance of humanitarian supply chain through benchmarking from performance assessment models (a case study: some of the last earthquakes in Iran)" carried out in management department of Tehran University (by current authors) in three phases before, during, and after earthquake with 13 performance dimensions and 44 performance indicators. Also we used output (factorial loads) of that study to determine

---

\* Corresponding author

Copyright © 2019, University of Isfahan. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits others to download this work and share it with others as long as they credit it, but they cannot change it in any way or use it commercially.

significance and weights of those dimensions and indicators. So that after considering these indicators and dimensions, by normalization, factorial loads of indicators and dimensions are considered as weights and significance. Then, we applied the gray approach and two scenarios to assess performance of three last catastrophic disasters in the country, the first scenario calculates the performance of every earthquake separately, and second one calculates the performance compared to an ideal earthquake which has the best indicators. Pervasive decision making of this approach (Gray approach) is presented in following steps:

- First step: creating decision making matrix
- Second step: normalizing decision making matrix
- Third step: defining reference option
- Fourth step: calculating Minkovsky distance
- Fifth step: calculating gray correspondence coefficient
- Sixth step: calculating gray correspondence score

The reasons to apply Gray approach are uncertainty in qualitative indicators, the ability to simultaneously consider quantitative indicators and uncertain numbers in order to integrate assessment procedure and to achieve a general conclusion. After considering earthquakes happened in the last two decades, with regard to constraint to access information and data of these earthquakes, three earthquakes of Ahar, Heris, and Varzaghan in east Azerbaijan Province (2012), Dashti in Bushehr Province (2013) and BashaGard in Hormozgan Province (2013) were selected because of proportional equivalence of conditions (equal amplitude, number of people influenced, required rescue aids) and availability of data and authorities, to compare these selected earthquakes considering those characteristics.

**Results and Discussions:** We expected that this study determine the performance of humanitarian supply chain in selected earthquakes in terms of performance dimension, three considered phases, and finally the whole supply chain.

In the first scenario, information of three earthquakes were used in different steps and performance status of three earthquakes was determined based on this information. It can be said that Bashagard earthquake condition is better than the two other earthquakes. Ahar and Dashti earthquakes have small difference. In terms of reaction phase to earthquake, Bashagard earthquake had less performance compared to other two earthquakes. In the phase of after earthquake, magnitude order was Ahar > Bashagard > Dashti; with regard to final results of the first scenario, East Azerbaijan earthquake (0.806) has better conditions than Bushehr earthquake (0.750) and Hormozgan (0.684). Minor differences between these numbers indicate that the performance of three earthquakes was very close and there is no great distinction among them.

A second scenario was considered in order to rationalize the comparison. With regard to results from this scenario, Bashagard earthquake in the phase of before earthquake had better condition and performance of Ahar and Dashti earthquakes were 0.403 and 0.4 respectively, that shows a small difference. In the phase of reaction to earthquake, Dashti, Ahar and Bashagerd earthquakes, respectively, have less distance with standard performance. Performance in the phase of after earthquake for Ahahr, Dashti, and Bashagerd were 0.460, 0.447, and 0.418, respectively. With regard to general results we can conclude that Ahar and Dashti earthquakes with 0.467 show similar performances and like the previous scenario, Bashagard earthquake (0.437) has the largest distance from standard and has undesirable performance compared to other earthquakes.

Performance scores are remarkable in two scenarios. Performances in the second scenario are less than the first scenario. This is normal, because Gray approach is based on distance from ideal state and in the first state, ideal state is acquired among available earthquakes, but in standard performance scenario, ideal state was defined based on existing standards with larger amounts. Then, normally distance of earthquakes to ideal are larger and lower performances are obtained.

**Conclusion:** Based on the second scenario which is more complete than first one, performances of humanitarian supply chain in Dashti and Ahar (Heris and Varzaghan) earthquakes are equal and better than that of Bashagard earthquake. In the end, it is noteworthy that this study has provided a framework to assess performance of humanitarian supply chain of the country in earthquakes that did not exist before and it could evaluate three earthquakes as sample earthquakes in the country.

#### References:

- Schulz, S. F., & Heigh, I. (2009). Logistics performance management in action within a humanitarian organization. *Management Research News*, 32(11), 1038–1049.
- Scholten, K. (2013). Are performance measurement systems sustainable tools ?