

APPLICATION OF LOGISTICS IN SOLVING CRISIS SITUATIONS

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Abstract

Logistics is being used primarily on supply and retail chains, but also it is an essential tool in solving crisis situations. Applied logistics refers to a set of applied principles and methods of logistics to solve problems in the physical distribution and flow of goods and services in various areas of society. Crisis logistics includes most of the circulation processes of logistics itself, such as procurement, warehousing, supply, or distribution logistics. The aim is to point out logistics principles in solving crisis situations. The work states planning and preventive actions in front of and during crisis situations and refers to the importance and impact of logistics in such situations. The main output is a micro and macro model of logistics of the current crisis situation.

Keywords: Logistics of crisis situations, Logistics principles, Planning, Logistics models

1. INTRODUCTION

Extraordinary events such as natural calamities, disasters, accidents, or wars can significantly impact life, human and animal health, or damage property. Crisis situations can have catastrophic effects and can affect large areas. They require many qualified civil protection people and an integrated rescue system that carries out rescue work and has the resources needed in crisis situations. It is essential to create a specific system for logistical support of crisis management [1]. Logistics coordinates and rationalizes activities to increase profits or reduce costs. From the point of view of a crisis situation, this is not the case because, in these situations, the priority is to protect human life at all costs and help when necessary [2]. The main goal is to apply logistics principles in solving crisis situations and to present the process and planning of solving problems with procurement, storage, and distribution in logistics models in the context of the recent crisis situation in the Slovak Republic.

2. METHODS

2.1. Definition of crisis logistics

Logistics management is an integral part of crisis management in many crisis situations. Management must be carried out at the various levels of government. It involves the preparation of action plans and strategies and the organization and monitoring of the implementation of the necessary tasks in assisting the affected population. From a logistics point of view, it is necessary to minimize the delivery time of supplies and health care to provide the persons concerned with the conditions for surviving the crisis situation. In addition to the proper use of available medical and material capacities, it is necessary to obtain and coordinate the necessary information flows [3]. Crisis logistics is a set of individual activities, including health service, delivery, displacement, accommodation, and protection. Material and financial flows usually support these activities. Operational management shapes, controls and monitors all processes in the logistics chain

that arise in a crisis situation [4,5]. Logistics decision-making in crisis situations is specific in that it is constantly under pressure. Outside crisis situations, the pressure of society's expectations ensures its survival in a crisis situation. In crisis situations, there is pressure from the risk of loss of life or health hazards [3]. Crisis management and humanitarian aid occur in dynamic and very limited environments, where there is more misinformation than truth. Managing a humanitarian logistics operation is more complex due to risks and uncertainties. For example, if part of the transport (road, rail, etc.) is affected, this negatively affects humanitarian operations [6]. Crisis management must perform different tasks at different stages of crisis situations. Crisis management tasks are divided into three basic periods: the preparation period, the implementation period, and the post-completion period. The preparation period is the most crucial period for crisis management. During this period, preventive measures are being prepared that directly affect the level of crisis management. This period includes the analysis and evaluation of risks and threats, the design of preventive measures to reduce or eliminate them and the development of the national defence system. The implementation period is important for saving human lives and material and spiritual values. Based on how quickly this period can respond to information about the occurrence of a crisis situation, its criterion of effectiveness is determined. It then uses analysis to determine what means and technical equipment it needs to intervene in any environment and time. The tasks of this period are to put all rescue and other means and forces into operation, provide care and information to the population, carry out activities directly related to rescue, localization and liquidation work, and prevent the spread of panic. In the third period, the resumption of the system's activities is concerned after the rescue work is completed, and the readiness of the rescue systems for re-use must also be restored [7-9].

2.2. Definition of humanitarian logistics

Humanitarian logistics is a branch of logistics that focuses on organizing the supply and storage of supplies in the event of any disasters or complex crisis situations for the affected area and people. It also covers resource optimization, inventory management, and information exchange. It is the process of planning, implementing, and controlling the efficient and cost-effective flow and storage of material and goods and related information from the place of origin to the place of consumption to alleviate the suffering of those affected by a crisis situation. Aid resources are obtained from local markets as much as possible. The role of humanitarian logistics is to map the market to determine what can be obtained within the region or the surrounding states. The aim is to eliminate the number of shipments from remote corners of the world as much as possible. The ultimate goal of humanitarian logistics is to minimize distribution time and cost and response maximization [10,11]. Their differences can be specified based on the above knowledge of crisis logistics and humanitarian logistics. Crisis logistics, therefore, consists of the crisis situation itself, the crisis management authorities and the crisis management itself. Planning and tasks are divided into three periods: the pre-crisis prevention period, the implementation period during the crisis situation and the post-crisis correction period. Crisis logistics includes risk analysis, preventive measures, management, and coordination of rescue services during a crisis situation and provides measures to remedy the system after a crisis situation. In the meantime, humanitarian logistics ensures the procurement, distribution, and storage of the necessary materials such as food, water, accommodation, medical equipment, and support with sufficient staff. They try to solve their tasks at the lowest possible cost and the shortest possible time [2].

2.3. Application of logistic principles in crisis management

Logistics is a multidisciplinary science that combines knowledge and principles of systems theory, control, decision making, optimization, simulation, modelling, economics, technology, engineering, and informatics. These postulates of logistics can be identified from the definition of logistics [12]:

- 1) system approach,
- 2) coordination,
- 3) planning,

- 4) algorithmic thinking,
- 5) global optimization.

“Logistics sees the object and the relationships within as a system” [12]. The logistics of crisis situations also systematically perceive its elements and links. It applies systematic decision-making to prevent the causes of a crisis situation and eliminate the effects of a crisis situation. “Coordination synchronizes the local goals of the system elements with the global goal” [12]. This principle is one of the two main ones for crisis logistics. It is used mainly in the implementation phase when precise and rapid coordination of rescue, protection and supply components is needed. The more errors that occur in coordination, the greater the likelihood of chaos and failure to meet goals. “Logistics flow goals are set in advance for a certain period, so they must be planned and predicted” [12]. Planning is the second fundamental principle in dealing with crisis situations. This principle applies mainly to the preventive phase. The more rigorously the preparation of possible procedures and measures is carried out, the more reliable the system will operate and deal with the undesirable situation. “Algorithmic thinking helps to follow a set plan precisely. It covers all possible situations, so no option should be left untreated” [12]. This principle is closely linked to the preparation of plans and the operational management of crisis logistics elements. If crisis management considers all options, the risk of mishandling and unnecessary delays in resolution is reduced. “The global goal is given by many criteria, which leads logistics to multi-criteria optimization” [12]. This logistics principle is generally not applicable in the case of crisis logistics. Crisis logistics still has the same goal - to eliminate the effects of health, life and possibly property-threatening situations.

3. RESULTS

This section aims to adapt the logistics of crisis situations to the real crisis situation. It focuses on the crisis situation on the Slovak-Ukrainian border: the influx of refugees from the war in Ukraine. At the same time, the post-pandemic COVID 19 pandemic is still occurring during the border crisis's implementation phase [2].

3.1. Macro model of crisis logistics

The macro logistics model consists of activities of strategic importance from the point of view of logistics that affect the course and structure of processes of the micro logistics model. It represents one-off activities with a long-term effect [12]. **Figure 1** illustrates the macro model of crisis logistics by adapting to a crisis situation.



Figure 1 Macro model of logistics of the crisis situation [2]

The choice of aid strategy means the form in which assistance will be provided to refugees. In our case, decentralized management was used, where the managed system was divided into several subsystems, which are managed separately. The individual subsystems are therefore managed mainly based on information from their subsystem, which includes, for example, the command centre, deputy, and assistant for logistics and communications [2].

Crisis centre allocation - refugees can apply for refuge in the following cities: Humenné, Michalovce, Nitra and Bratislava. The Aliens Police Department handles the registration of temporary refuge. Detention camps for refugees are being closed, and the entire infrastructure will be relocated to Michalovce and Humenné, where large-scale vaccination centres have operated so far. [2].

Organization of refugees' residence - after the entry of a refugee into the territory of the Slovak Republic, a so-called "Funnel" is created, which in practice means that the refugees are asked whether he wants to stay in the Slovak Republic. If he wants to, he must present the documents; he must obtain the documents if he does not have them. If he has the documents, the refugee will apply for the status of a resident. If he does not stay in the Slovak Republic, he will be provided with basic information about the crossing of our territory [2].

Strategy against the spread of COVID 19 - refugees can be tested upon arrival in the territory of the Slovak Republic, and it is not mandatory. In case of a positive result, it is recommended to set aside several accommodation units for these persons to avoid contact with people without the disease [2].

Integration planning concerns a refugee if he/she remains in the territory of the Slovak Republic. The purpose of the planning is to prepare the conditions and define the rules of employment, business, urgent and possibly other health care. Upon request, the refugee's child can attend school. The Slovak Railway Company has introduced free transport for Ukrainian citizens with an identity card [2].

3.2. Micro model of crisis logistics

The micro logistics model is a functional model of the company's internal flows. The basic cross model represents the horizontal flow of material and the vertical flow of information and decision making [12]. **Figure 2** shows the material and information flows of a functional cross-model of the humanitarian aid system to refugees [2].

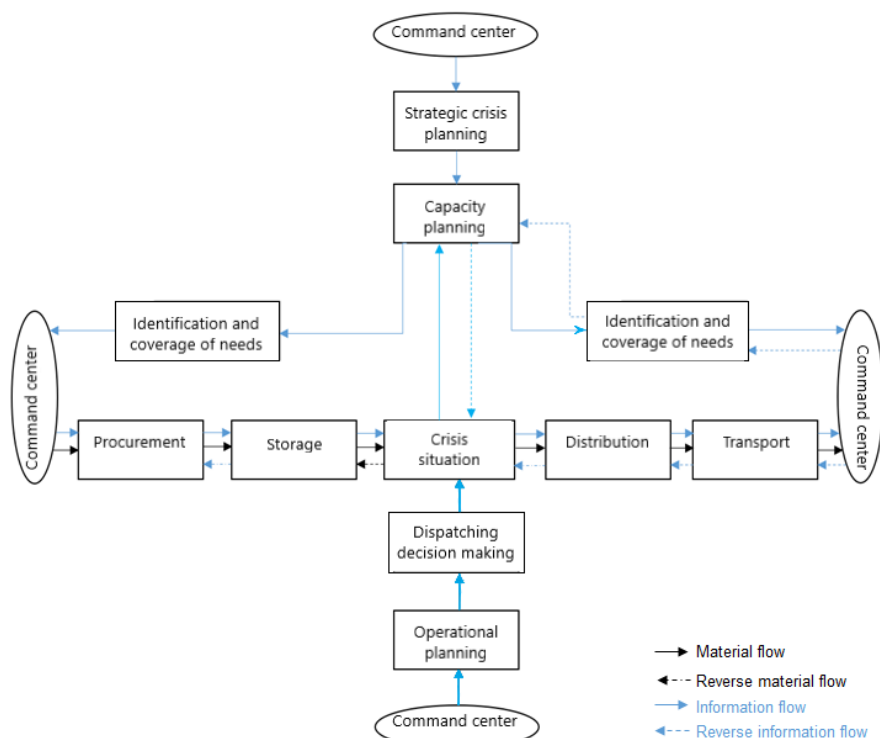


Figure 2 The basic cross micro model of the current crisis situation [2]

The command centre oversees strategic and capacity planning. The deputy and the supervisor must have accurate information on the number of technical means, people crossing the border, and the number of rescue

and law enforcement. Based on this, the command centre issues enlistment and mobility orders. Information service is also significant, where all people can find out everything about the current situation at the border or about the possibilities of voluntary help. The information flow passes from capacity planning to identifying and covering needs and then travels back to the operations centre. Coordinators must keep track of the stocks that are in the warehouse. If something is missing, it must be procured and then sent to the warehouse. Material from the warehouse goes directly to the border or where it is needed. Coordinators and dispatchers issue these orders from the command centre where the material should go. If there is an excess of a particular material at the border, it must be sent back to the warehouse to make room in the area in question [2].

4. CONCLUSION

The planning process plays a crucial role in creating, implementing, and applying logistics principles, regardless of the situation. The result is an operational plan that allows for the timely fulfilment of the tasks of the contingency plan and the use of control mechanisms to speed up activities and verify the accuracy of information with immediate implementation of changes in the situation. It is an extensive and costly complex of tasks and measures [13]. After applying the principles of logistics to the solution of the crisis situation in question, **Figure 3** shows the planning process of this crisis situation.

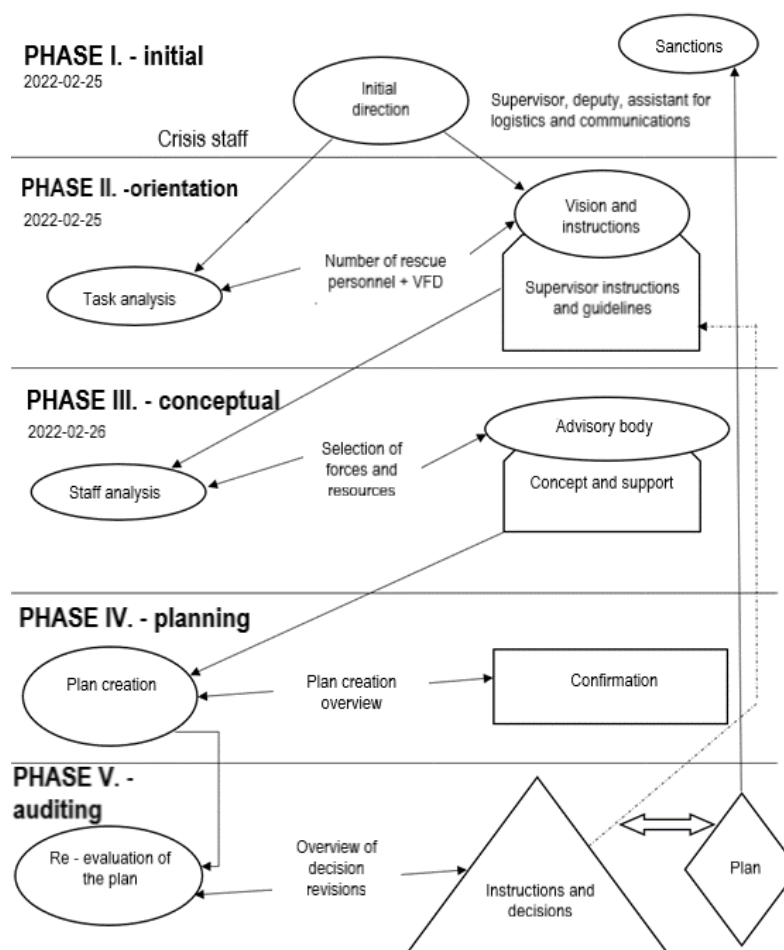


Figure 3 The current crisis planning process [2]

The first phase began on February 25, 2022. When the crisis staff meets in their emergency department, where a supervisor heads the crisis staff, there is also a deputy and assistant for logistics and communications. The Ukrainian side has provided the crisis staff with information on the number of people already on the move

so that the situation at the border can adapt. Everything went to the second phase, where the crisis staff analysed how many members were currently available to ensure that the unit's ability to act was not weakened. The corps' activities are also non-humanitarian in terms of the law. Hence, it was necessary to call a rescue unit from the Czech Republic. At the same time, the volunteer fire brigades of the Slovak Republic were put on standby and in action. In Phase 3, February 26, 2022, everything started moving in the morning, but the first three days were chaotic because there was no advisory body. Everything took place in Michalovce and Sobrance without an information link. One of the main logistics functions failed. After two days, this problem was solved by calling all staff vehicles, which serve as material and technical equipment. Three staff vehicles were connected to a computer and GPS network. Vehicle dispatchers controlled the transmission of information to facilitate activities at regional command centres. From the beginning, the planning period was one day. After the situation stabilized, the planning period was extended to one week, later one month. In the fourth phase, a comprehensive plan is created, and in the fifth phase, the supervisor prepares and distributes instructions and tasks to all concerned persons in the system.

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REFERENCES

- [1] DETZER, S., et al. Assessment of Logistics and Traffic Management Tool Suites for Crisis Management. In: *European Transport Conference*. 2016, p. 18.
- [2] MUZIK, J. *Analysis of the possibilities the logistics principles applying in solving crisis situations*. 2022, p. 49. Bachelor thesis. Technical University of Kosice.
- [3] SOBOŇ, D. Organization of logistics management in a crisis situation. *Globalization, the State and the Individual*. 2019, no. 4, pp. 43-49.
- [4] BRITCHENKO, I., et al. Logistics management in crisis situations. Bulgaria, 2018, p. 13.
- [5] SVENTEKOVÁ, E.: Logistics support of crises situations solving. Mechanics, Transport, Communications. In: *Transport 2009 conference*, pp. 40-43.
- [6] ÇELIK, M., et al. Humanitarian logistics. In: *New directions in informatics, optimization, logistics, and production*. *INFORMS*. 2012. p. 18-49.
- [7] FILIP, S., ŠIMÁK, L. *Manažérstvo rizík a krízových situácií vo verejnej správe. Risk and crisis management in public administration*. Bratislava: Merkury. Stratégia rozvoja slovenskej spoločnosti, 2006, p. 208.
- [8] PONIŠT, S. *Krízový manažment v doprave na národnej úrovni. Crisis management in transport at the national level*. Zilinska Univerzita, Zilina, p. 6.
- [9] BABNIČOVÁ, B. *Analysis of crisis management options in the city*. 2012, p. 74. Bachelor thesis. Univerzita Tomase Bati v Zline.
- [10] NURMALA, N., DE LEEUW, S., DULLAERT, W. Humanitarian–business partnerships in managing humanitarian logistics. *Supply Chain Management: An International Journal*. 2017, vol. 22, pp. 82-94.
- [11] WEBEROVA, A. Humanitární logistika: Boj nejen s časem, Humanitarian logistics: Fighting not only with time. [Online]. 2013. [Viewed: 2022-05-18]. Available from: [Humanitární logistika: Boj nejen s časem - Systémy Logistiky CZ \(systemylogistiky.cz\)](http://systemylogistiky.cz)
- [12] ROSOVÁ, A. *Podniková logistika. Business logistics*. TU Kosice: FBERG, 2012, p. 100. ISBN 978-80-553-0881-4.
- [13] PETRUF, M., VIRDZEK, P. Logistics of crisis situations. Logistika krízových situácií. *Transport & Logistics*. 2005, vol. 5, pp. 55-67.