Analysis on the Survivability of Equipment Support System of Non War Military Operations Based on Operational Efficiency

Ou Qi*, Lei Zhang2, Wenhua Shi3 and Yanli Wang4

1 Army Academy Of Amored Forces, Changchun, China
2 Changchun Military Representative Office of Shenyang Military Representative Bureau of Ground Force, Changchun, China
3 The Army of 95795, Guilin, China
4 PLA 32256 Troops, Yunnan, China

*Corresponding author: haikuotiankongru@163.com

Abstract. In the process of carrying out the mission, the equipment support system of non war military operations will be interfered and destroyed by various kinds. How to ensure the normal operation of the equipment support system of non war military operations under the interference and destruction is an important factor that restricts the effectiveness of our military non war military operations. Therefore, scholars at home and abroad have carried out a lot of research.

Keywords: Non War Military Operations, Equipment Support, Operating Efficiency

1 Introduction
Aiming at the cascading failure of equipment support system, Wu Jun proposed a cascading failure model of complex load network based on load redistribution by using the evolution of node weight instead of the evolution of network topology[1-2]. According to the operation characteristics of modern equipment support system, they constructed the complex network dynamics simulation model of equipment support system, which provided theoretical basis for the selection of key nodes of equipment support system[3-7]. Based on the research of material transportation of the equipment support system, the evaluation method of the invulnerability of the equipment support system based on the shortest path number is put forward. Based on the comparison of scale-free network, random network and complex support network, Li Yong established the cascaded failure resilience model of complex support network under different network traffic[8-11]. To some extent, the above research solves the problem of survivability evaluation in the process of equipment support system construction, but it does not take into account the factors of operation efficiency of equipment support system, resulting in poor usability of research results in non war military operations equipment support[12-13]. In the process of evaluating the survivability of urban public transportation system, Jiang Tao put forward the concept of system operation efficiency. Based on Jiang Tao's thought, this paper constructs the survivability model of equipment support system for non war military operations based on operational efficiency, and analyzes the problem of equipment support for non war military operations. The research results show that the introduction of operational efficiency index in the analysis process can improve the practicability of the evaluation results.
2 Model Construction

The equipment support system of non war military operations includes two basic elements: node and line. A line consists of several nodes. Based on the investigation of the relationship between the equipment support system of non war military operations and the transfer characteristics of the equipment support system of non war military operations, this paper constructs the equipment support line of non war military operations and the nodes of the equipment support system of non war military operations.

The model assumes that:

A) In non war military operations, fixed-point support, accompanying support and support are mainly considered, while other support modes are not considered temporarily;

B) Assume that the non war military operation equipment that cannot be connected to the support point by route is an isolated point and cannot fulfill its support mission;

C) There is no difference in the driving direction of support vehicles between the two nodes, and the equipment support system network of non war military operations is non weighted topology structure.

3 Invulnerability Analysis

The equipment support system of non war military operations faces two kinds of damage: random damage and selective damage. In the actual network of equipment support system for non war military operations, when a node is damaged, the route of equipment support system for non war military operations passing through the node can be changed or some temporary nodes can be set, keeping the starting station and terminal station basically unchanged. In this case, the research is complex. In this paper, a simplified treatment is made: suppose a node is destroyed and all the edges connected with the node are deleted, that is, the original route of equipment support system for non war military operations is divided into two routes.

3.1. Applicability Analysis

At present, the commonly used index to study the invulnerability is the average shortest path theory, which holds that when the equipment support system is not damaged, the transportation path of the support materials is the shortest. When some nodes of the support network are damaged, the materials originally passing through this node must be transferred to the target node through other nodes. The destruction of the support system nodes makes the equipment support. The shortest support path of the system is extended. By measuring the change of the shortest connected path of the support system, the damage degree of the equipment support system can be calculated. This theory can better measure the damage degree of the equipment support system at the beginning of the damage of the equipment support system, but with the deepening of the damage of the equipment support system, there will be some isolated nodes in the support system, which seriously reduce the support effect of the support system, but the path of these nodes to transport support materials is 0, which lowers the average shortest path value of the support system. When the equipment support system is seriously damaged, the calculation results are inconsistent with the damage degree of the system.

3.2. Proposal of Operation Efficiency

In order to solve the problem of traditional methods in calculating the operation efficiency, this paper puts forward the concept of operation efficiency. Assuming that the distance between the two nodes I and j of the support system is DIJ, the operation efficiency is the reciprocal of the node distance, i.e. the operation efficiency

\[ \beta_{ij} = 1 / d_{ij} \]  

(1)

The operation efficiency of the whole system is the average value of the efficiency among all nodes, that is:
\[ \beta = \frac{2}{N(N-1)} \sum_{i \neq j} \beta_{ij} \] (2)

In the formula, it represents the operation efficiency between \( ij \) two nodes, represents the number of nodes in the support system, represents the overall efficiency of the support system, and eliminates the contribution of isolated nodes to the operation efficiency. In the above formula, when all nodes of the support system are connected, when all nodes are isolated.

4 Result Analysis
It can be seen from the analysis results that the network of equipment support system for non war military operations is robust to random damage and vulnerable to selective damage. Therefore, the survivability performance of equipment support system network of non war military operations is closer to that of scale-free network. This phenomenon is caused by the heterogeneous structure of the equipment support system of non war military operations. From the damage sequence, it can be seen that the most important nodes are the first ones to be damaged. These nodes play an extremely important role in the connectivity of the equipment support system network of non war military operations. When these nodes are destroyed, the equipment of non war military operations will be made. The structure of the support system changes dramatically, resulting in too many isolated nodes, resulting in the network paralysis.

5 Conclusion
When the random damage is carried out, the probability of just destroying this node is much smaller, so it needs to destroy relatively many nodes to make the network paralyzed. Therefore, it is necessary to strengthen the support of the normal and high level of this kind of nodes (non war military operation equipment support system hub nodes). Effective operation is the key to network management and optimization of equipment support system in non war military operations.

References
[1] S. Ali, J. Baird, A.M. Napoli. 58 Utility of Physician-in-Triage Intake Model to Mitigate the Impact of Boarding on Emergency Department Operational Efficiency[J]. Annals of Emergency Medicine, 2019, 74(4).
[2] Shuang Zhang, Ying Li, Haichao Yuan, Deping Sun. An alternative benchmarking tool for operational energy efficiency of ships and its policy implications[J]. Journal of Cleaner Production, 2019, 240.
[3] Sousa V, Dias-Ferreira C, Fernández-Braña A, Meireles I. Benchmarking operational efficiency in waste collection: Discussion of current approaches and possible alternatives.[J]. Waste management & research: the journal of the International Solid Wastes and Public Cleansing Association, ISWA, 2019, 37(8).
[4] Reed Grant W, Tushman Michael L, Kapadia Samir R. Operational Efficiency and Effective Management in the Catheterization Laboratory: JACC Review Topic of the Week.[J]. Journal of the American College of Cardiology, 2018, 72(20).
[5] Dong Gang, Zhu Jing, Li Jin, Wang Handong, Gajpal Yuvraj. Evaluating the Environmental Performance and Operational Efficiency of Container Ports: An Application to the Maritime Silk Road.[J]. International journal of environmental research and public health, 2019, 16(12).
[6] Hino Raymond T. PRACTITIONER APPLICATION: Operational Efficiency Using an In-House Ambulatory Surgery Model at an Academic Medical Center.[J]. Journal of healthcare management / American College of Healthcare Executives, 2018, 63(2).
[7] Tayne Samantha, Merrill Christian A, Saxena Rajeev C, King Caitlin, Devarajan Karthik, Ianchulev Stefan, Chilingerian Jon. Maximizing Operational Efficiency Using an In-House Ambulatory Surgery Model at an Academic Medical Center.[J]. Journal of healthcare management / American College of Healthcare Executives, 2018, 63(2).
[8] Akin Seckin. Hysteresis-free Planar Perovskite Solar Cells with a Breakthrough Efficiency of 22% and Superior Operational Stability over 2000 Hours.[J]. ACS applied materials &
interfaces, 2019.

[9] Energy; Lulea University of Technology Reports Findings in Energy (Exploring the Effects of Several Energy Efficiency Measures On the Embodied/operational Energy Trade-off: a Case Study of Swedish Residential Buildings)[J]. Energy Weekly News, 2019.

[10] Jeff Long, Dan Fu, Christine De Sario. Tunable technology improves operational efficiency in the Eagle Ford[J]. World Oil, 2019.

[11] Science - Operational Research and Management Science; Findings from Sapienza-University Provide New Insights into Operational Research and Management Science (Efficiency, Effectiveness, and Impacts Assessment In the Rail Transport Sector: a State-of-the-art Critical Analysis of Current Research)[J]. Science Letter, 2019.

[12] TrueLight Energy; The REP Pricing App that's Redefining Operational Efficiency[J]. Energy Weekly News, 2019.

[13] Fuel Research; Studies from University of Science and Technology Beijing Have Provided New Data on Fuel Research (Effects of Operational Conditions, Anions, and Combustion Flue Gas Components In Wfjd Systems On Hg-0 Removal Efficiency)[J]. Energy Weekly News, 2019.