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Cargo transport management in the military sector

Tomasz Jałowiec*, Katarzyna Pierzyk-Wiszowaty

War Studies University, Warsaw

Abstract: From the beginning of military activity, transport played a priority role in implementing military security tasks, guaranteeing the success of operations or wars. Over the years, significant changes in the implementation of tasks in transport and military movement can be observed, which took place in the technological, infrastructure, and management dimensions. Thanks to new discoveries and introduced modifications, the ability to implement military transport was increased in accordance with the dynamically changing needs of operational troops. The research problem has been specified in the following form: What factors impact the development of cargo transport capacity in the military sector? The material uses several research methods, the leading of which were: analysis and synthesis, querying the literature on the subject, abstraction, and inference. The diagnostic survey was conducted using an expert interview technique as an empirical method. The article identifies the factors most influencing the development of cargo capacity in the military sector, simultaneously pointing to the need to tighten the cooperation undertaken in this area between the civil and military circles. Particular attention was paid to factors that critically impact the development of transport capacity in the military sector. The obtained results made it possible to indicate that the development of the military cargo transport capability is a priority in the process of improving the military transport and movement subsystem. Particular attention should be paid to enhancing managerial abilities, which are a crucial element in ensuring appropriate conditions for the performance of tasks by the armed forces.
Keywords: transport, military logistics, cargo

1. Introduction

During all military operations, regardless of their nature, the issue of the movement of military forces and resources to the task areas plays a key role. The transport of soldiers and necessary goods is carried out using the armed forces' potential and acquired transport means from the civilian market. The planning, organization, and execution of individual transport processes are the responsibility of the entities of the military logistics system located primarily in its specialized subsystem of transport and movement of troops. The purpose of the troop transport and movement subsystem is to ensure the efficient and timely movement

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*Corresponding author
E-mail address: t.jalowiec@akademia.mil.pl (T. Jałowiec), k.wiszowaty@akademia.mil.pl (K. Pietrzyk-Wiszowaty)
ORCID: 0000-0002-6974-090X (T. Jałowiec), 0000-0003-3992-5775 (K. Pietrzyk-Wiszowaty)

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of troops, armaments, and military equipment, as well as supplies in times of peace, crisis, and war, including the provision of necessary weapons, ammunition, tents, and rations as required [19]. The essence of the transport and movement of troops subsystem, on the other hand, is the preparation of the resources of transport means, transport network, authorities, and executive units (military and civilian) for the implementation of the tasks of transport and movement of troops [26].

Today, there is a significant increase in military activity on the eastern flank of the North Atlantic Treaty Organisation (NATO), resulting primarily from the situation in Ukraine, attacked on 24 February 2022 by the Russian Federation. A sharp increase in the threat level near NATO countries, which has not been directly experienced for many years, has necessitated dynamic changes in many areas of the operation of individual countries' armed forces and Alliance-wide procedures. One of the key areas affecting specific operational capabilities of the armed forces is the sphere of transport, in which, as experience to date shows, there are real needs and expectations for improving existing solutions.

Given the problem situation briefly outlined above, the article aimed to identify the factors that most influence the development of cargo capacity in the military sector. The research problem taken up for solution was specified in the following form: What factors most influence the development of cargo capacity in the military sector? Several research methods were used in the material: analysis and synthesis, literature search, abstraction, and inference. A diagnostic survey was carried out using the expert interview technique as an empirical method. Due to the adopted research limitations, the efforts were concentrated on the essence of the problem undertaken to solve while at the same time indicating future directions of research on the extremely topical and multifaceted problem, which for the armed forces remains the issue of improving the transport and movement subsystem of troops.

2. Dimensions of cargo management in the military sector

A compliant flow of cargo in the armed forces requires detailed planning and organization of each stage of the transport process, as well as the ability to anticipate the various adverse events and situations that may arise during its implementation. In this area, it is necessary to consider the highly variable and uncertain characteristics of natural processes, the possibility of various disruptions, limited resources, time constraints, and economic conditions [4]. Thus, the focus should not only be on the planning process itself, but all management processes associated with it should be taken into account. Experience clearly shows that it is essential for the proper implementation of transport processes in the armed forces to make widespread use of assumptions that form the basis of strategic management. Today, strategic management plays a special role among the sub-disciplines of management and quality sciences [20]. The literature on the subject, both foreign and domestic, is rich in definitions of strategic management, while over the years, the focus of research has changed. Several theories have been developed in response to the different needs of industries and companies, including agency theory (Jensen and Meckling, 1976), resource-based theory (Wernerfelt, 1984), invisible asset theory (Itami and Roehl, 1987), and competence-based theories (Prahalad and Hamel, 1990) [15]. Thus, a clear and precise definition of the concept is difficult. The most common accent is that it is a continuous process of monitoring the company's environment and potential and building and implementing an effective strategy

to increase its competitiveness and improve its market image in the long term [23]. As defined by W.F. Glueck, strategic management is a stream of decisions and actions that lead to the construction of an effective strategy or effective strategies to achieve the company's objectives [17]. In a similar sense, the term is interpreted by A. Kazmi, stating that it is a dynamic process of strategy formulation, implementation, evaluation, and control to achieve the organization's strategic intention [24]. Thus, all activities, processes, and decisions related to strategy can be considered a manifestation of strategic management [6].

The management literature identifies four key dimensions (elements) of strategic management, which include: organizational leadership, assessment and analysis of the situation, formulation of corporate objectives and strategy, and implementation of the adopted strategy in the enterprise. Transposing the formulated and continuously improved assumptions of strategic management to the area of transport and movement of troops, it is necessary to point out the key dimensions of transport management in the military sector (Fig. 1.).

Fig. 1. Priority dimensions of transport management in the military sector (source: own elaboration)

The priority dimensions of transport management in the military sector presented in Figure 1 are certainly not of a closed nature. What is more, they should be treated only as determinants in improving transport management for the needs of the armed forces. Referring to the first dimension - *Objectives and strategy for the development of the transport and movement subsystem of troops resulting from the objectives of the Polish* Armed Forces *and NATO* - it is worth emphasizing that the Polish Armed Forces maintain continuous readiness for three types of missions, i.e. [11]:

- guaranteeing the defense of the state and resisting aggression,
- participation in the international stabilization process, crisis response, and humanitarian operations,
- promoting internal security and assisting the public.

Poland's accession to NATO in 1999 resulted in the Polish Armed Forces interacting in many dimensions with the armies of other countries in pursuit of the Alliance's common policy, aimed in particular at protecting the freedom and security of allies through political and military means. In light of these considerations, it is also worth noting that in addition to its traditional role in the territorial defense of allied states, NATO leads the UN-mandated International Security Assistance Force (ISAF) in Afghanistan and conducts missions in the

Balkans and the Mediterranean. It also conducts extensive training exercises and offers security support to partners around the world, including in particular the European Union, but also the United Nations, and the African Union [9].

The stated objectives of the Polish Armed Forces and NATO translate directly into the directions of development of individual areas of the military's functioning. To a large extent, this also applies to the sphere of military mobility, which requires the continuous development of transport means and infrastructure of all branches of transport in terms of its possible use for the needs of the state defense system.

The organizational dimension of transport management in the military sector results from the structure of the transport and movement subsystem of troops in the SZ RP. In structural terms, the army transport and movement subsystem of the SZ RP is a common element of the functional system of logistics of the SZ RP, the transport system of the state, and the transport system of NATO and the European Union. The organizational structure of the army transport and movement subsystem is divided into three levels following the command system of the SZ RP, that is: strategic, operational, and tactical. The adopted structure is identical to the levels of military mobility, which is a flagship undertaking in EU-NATO cooperation [12], referred to as [5]:

- strategic mobility is the ability to move troops and military equipment efficiently and on time over a long distance between a country's area and an Alliance combined operations area or between combined operations areas,
- operational mobility is the ability to move troops and military equipment effectively and on time in a combined operations area,
- tactical mobility is the ability (own or external) to move troops and military equipment efficiently and on time over short distances, usually in a combined operations area.

In characterizing the organizational structure of the army transport and movement subsystem, it is important to point out the leading role (leadership) of the Army Transport and Movement Headquarters - Army Movement Coordination Centre (STiRW-CKRW), which acts as the National Military Command Centre (NMCC). Its tasks include [10]:

- development of the concept of troop movements and the principles of operation of the troop transport and movement system in the Polish Armed Forces,
- development of plans for the use of the country's transport network by the Polish Armed Forces and participation in the development and updating of plans for the technical protection of the transport network of defense significance,
- to act as the Central Logistics Authority and as the Gestor of the reloading and troop movement security equipment,
- planning and coordinating the movement of own and allied troops within the country,
- planning and coordinating the movement of Polish military contingents assigned to missions (operations) abroad,
- preparation of rules and plans of action and the organization and formation of Troop Movement Coordination Centres in crisis and war situations in cooperation with NATO,
- issuing road transit permits for columns, non-normative vehicles, and vehicles transporting hazardous materials belonging to the Polish Armed Forces and foreign troops,
- carrying out tasks related to the assignment and use of the Uniform Material Index for reloading equipment and securing the movement of troops,

- performs the functions of the organizer of the KONWÓJ ICT system and performs the tasks of building the capacity of the Polish Armed Forces concerning the Parcel Monitoring Subsystem,
- developing concepts and programs and supervising the training system for candidates for Cat "C" and "C+E" drivers and loading equipment operators in the armed forces,
- registering and issuing registration documents for vehicles of the Polish Armed Forces.
- develops rules and procedures for the movement of troops and cargo,
- coordinates the tasks of procuring various modes of transport for military transport in cooperation with civilian carriers,
- is the organizer of the transport and troop movement subsystem of the Polish Armed Forces.

STiRW-CKRW carries out the tasks mentioned above in coordination with the Ministries of Infrastructure, Maritime Affairs, and Inland Navigation and Environment, as well as road, rail, water, and air administrations. At the operational level of the Polish Armed Forces (SZ RP), the elements of the transport and troop movement subsystem are the Departments of Transport and Troop Movement and HNS (Host Nation Support) located at the Regional Logistics Bases (RBLog). At the tactical level, the executive bodies of the transport and troop movement subsystem are responsible for ensuring the smooth movement of troops following plans. These are the Army Transport Commands, the Delegations of the Army Traffic Regulation Commands, and the Traffic Regulation Companies [14].

Another important dimension from the perspective of transport management in the military sector is the location of the troop transport and movement subsystem in the structure of the armed forces logistics system. This system comprises six subsystems, i.e., command, material, technical, troop transport and movement, military infrastructure, medical, and two functional areas: *host nation* support (HNS) and mobilization of the economy and strategic reserves. In such a complex structure, the army transport and movement subsystems are perceived as a multi-level, coherent system of forces and means, as well as organizational and technical. It is undertakings directly related to the transport and movement of troops and planning and coordinating the preparation and use of the country's transport infrastructure for the state's defense needs in cooperation with the economic defense cells of the non-military subsystem competent for transport, as well as determining the requirements and operational and technical needs for the development of plans for the technical protection of the state's transport infrastructure [1, 21, 26].

For proper transport management in the military sector, the ability to implement changes as a result of ongoing analysis of the environment and assessment of the impact of the political, military, and economic situation, particularly, is of particular importance. Thus, various modes of transportation are adapted to the needs and situations that arise. Considering the structure of military transportation from 2014 to 2022, a dynamic increase in freight work is discernible, particularly in road transport (up 55%) and rail transport (up 30%), as shown in Table 1.

The relevance of this dimension of transport management in the military sector has been particularly demonstrated by events resulting from the dynamic increase in North Atlantic Alliance activity on NATO's eastern flank following the Russian Federation's aggression against Ukraine. A perceptible increase in this area is the growth of training ventures of a tactical nature, as well as command and staff, resulting in greater demand for the movement of supplies, armaments, and military equipment.

Table 1. Structure of military transportation by the branch from 2014 to 2022 [13]

Mode of transport	2014	2015	2016	2017	2018	2019	2020	2021	2022	Comment
Road transport	8618	9440	10225	11835	12852	3530	2506	3362	15617	Based on the number of "Road Permits" issued.
Rail transport	122	187	198	411	314	288	220	254	401	Operational transports and supplies
Air transport	239	170	224	281	231	174	99	91	89	SALIS* and SAC** flights and from contracts. Commercial. Excluding flights of C-295 and C-130.
Maritime transport	7	5	1	2	0	6	3	1	42	

*SALIS - *Strategic Airlift International Solution*
**SAC - *Strategic Airlift Capability*

In conclusion, this article's first part should particularly emphasize the complexity and multidimensionality of transport management in the military sector. The challenge for the further development of this extremely important area of the armed forces' functioning will certainly be to identify the factors that most influence the development of cargo transport capacity in the military sector. To this end, it proved necessary to conduct empirical research, a description of which is presented in the second part of the article.

3. Improving cargo transport capacity in the military sector

Based on the literature research carried out by the author's team, to solve the defined research problem, it proved necessary to carry out empirical research. Due to the nature of the area under study, qualitative research carried out using the diagnostic survey method with the expert interview technique was selected as the most appropriate. Prepared interview sheets containing four open-ended questions were addressed to 7 experts representing all functional levels of the transport and army movement subsystem. The criteria for the selection of experts were two, taken together. The first was a minimum of 5 years of service within the subsystem in question, and the second related to completed studies and courses in the area of transport management. The study proper, preceded by a pilot, was conducted in May-July 2022.

The interview sheet comprised four open-ended questions in wording:

1. Which qualitative characteristics of cargo transport in the military sector do you consider a priority?
2. What is negatively affecting the quality of cargo transport in the military sector today, and to what extent?
3. What factors most influence the development of cargo capacity in the military sector?
4. What changes should be made first to improve the efficiency of cargo transport in the military sector?

Due to the limited scope of the present material, the empirical results obtained have been aggregated and presented in Table 2.

Table 2. Summary of the results of empirical studies on improving cargo transport management in the military sector

	Question	Aggregated expert opinions
1.	Which qualitative characteristics of cargo transport in the military sector do you consider a priority?	– the lead time for the various stages of the transport process; – security of task execution at individual stages of the transport process; – reliability of means of transport; – qualification of personnel/level of training of soldiers and military personnel performing tasks at all levels of the transport and troop movement subsystem – flexibility in the ability to increase the intensity of cargo flows; – the degree to which transport assets, the transport network, authorities, and military and civilian executive units are prepared to carry out a wide range of transport tasks for the troops; – Unification/level of compatibility of transport and handling equipment with allied capabilities; – the ability to monitor the transport and movement of troops in real-time.
2.	What is negatively affecting the quality of cargo transport in the military sector today, and to what extent?	– inadequate interconnection of the infrastructure of the various modes of transport; – limited possibilities for multimodal transport; – too small a fleet of vehicles in the armed forces dedicated to the transport of dangerous goods (EX/II, EX/III certified vehicles) – the low load-bearing capacity of roads, bridges, and viaducts when carrying heavy loads; – high costs associated with the use of rolling stock; – restrictions due to environmental regulations, i.e., increased concentrations of pollutants (smog) caused, for example, by exhaust fumes, noise emissions from means of transport; – traffic accidents - the likelihood increases with higher traffic volumes caused, for example, by reduced freight times; – high variability in freight intensity; – variable weather conditions and the likelihood of adverse events on roads and other transport routes;
3.	What factors most influence the development of cargo capacity in the military sector?	– saturation with modern military equipment, including reloading; – interoperability and compatibility through the military transport subsystem within NATO and the EU; – the level of education and competence of personnel at all levels of the transport and troop movement subsystem; – developing Host Nation Support (HNS) capabilities; – building a modern scientific and research capacity for military cargo capacity.
4.	What changes should be made first to improve the efficiency of cargo transport in the military sector?	– increase the number of vehicles and trailers dedicated to the transport of EX/II and EX/III dangerous goods; – introduce into the armed forces equipment certified containers with a wall thickness of min. 10 mm for the transport of dangerous goods; – implement monitoring of freight transport by road and rail not only in Poland; – exempt the armed forces from the procurement law in non-standard situations for military transports; – reduce the time taken to issue approvals for the movement of columns of military vehicles; – create modular structures in the transport and troop movement subsystem, – improve civil-military cooperation in the area of transport - multi-annual agreements.

Source: compiled from the results of the expert survey.

In an attempt to generalize the results collected during the research process and summarised in Table 1, it should first be pointed out that all the experts agreed that there is a real need to urgently improve aspects of cargo transport management in the military sector. In expressing their opinions, they specifically pointed to the specific nature of the implementation of transport tasks for the armed forces, which determines, and in many cases limits, the real possibilities for rapid transformation of subsystem elements and troop movements. They were also unanimous on the growing role of logistical civil-military cooperation in cargo transport. Furthermore, in the positions presented, it was possible to perceive the indication of the need for a thorough modification of the legal conditions regulating the implementation of transport services by and for the armed forces. In this case, three solutions functioning in the US army were indicated, which could constitute a benchmarking model for the Polish Armed Forces.

The theoretical and empirical research not only solved the identified research problem but also provided a basis for further, extended research aimed at the continuous improvement of cargo transport management in the military sector. Because of the limited scope of this article, the most significant challenge proved to be the collation of the results obtained in terms of their comprehensive comparison against the detailed opinions of experts representing all functional levels of the military transport and movement subsystem. This approach, however, allowed cross-sectional results to be obtained, providing a basis for the presentation of scientific conclusions to guide further multidimensional work on improving the management of cargo transport in the military sector.

4. Conclusions

The results obtained in the research process mandate the following general conclusions:

1. The results of the research indicate that the key factors influencing the development of cargo capacity in the military sector include: the level of qualification of personnel in the military transport and movement subsystem at all levels, the strengthening of scientific and research capacities for cargo capacity, the modernization of military equipment and the flexibilization of formal and legal procedures for military transport.
2. The priority quality features in the transport of cargo in the military sector today are the time and safety of the various stages of the transport process.
3. A particularly desirable feature in the transport and troop movement subsystem, given the dynamically increasing level of training and operational cooperation within NATO and the EU, is the development of the level of interoperability and compatibility of transport and handling equipment and procedures for the implementation of transport processes.
4. Improving the efficiency of cargo transport management in the military sector depends primarily on the level of education and competence of personnel of the military transport and movement subsystem at all levels and the development of logistical civil-military cooperation in the transport area.
5. The desired direction of change of cargo transportation in the military sector should be focused on improving and retrofitting the armed forces with specialized transport equipment necessary for transporting dangerous goods.

6. There is a real need to speed up and simplify formal and legal procedures for civil-military cooperation in the area of transport to optimize the implementation of the transport process.

In conclusion, it should be emphasized that systematic scientific research in the field of transport management in the military sector is extremely important due to the dynamic changes taking place in both the international and national security environment. Furthermore, due to the close correlation between the operation and development of transport in the civilian and military spheres, a wide-ranging exchange of views and joint interdisciplinary research by researchers representing, in particular, the scientific disciplines of civil engineering and transport, management and quality sciences and security sciences is essential.

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Zarządzanie transportem ładunków w sektorze militarnym

Streszczenie. Realizacja szerokiego spektrum zadań stawianych przed siłami zbrojnymi we wszystkich stanach funkcjonowania państwa jest nierozerwalnie związana z przemieszczaniem określonych sił i środków. Od początku działalności wojskowej, transport odgrywał priorytetową rolę w realizacji zadań zabezpieczenia wojsk, będąc gwarantem sukcesu prowadzonych operacji czy wojen. Na przestrzeni lat zaobserwować można wyraźnie duże zmiany w zakresie realizacji zadań w obszarze transportu i ruchu wojsk, które zachodziły w szczególności w wymiarze technologicznym, infrastrukturalnym oraz zarządczym. Dzięki nowym odkryciom oraz wprowadzanym modyfikacjom uzyskiwano wzrost zdolności do realizacji transportu wojskowego zgodnie z dynamicznie zmieniającymi się potrzebami wojsk operacyjnych. Podjęty do rozwiązania problem badawczy został sprecyzowany w następującej postaci: Jakie czynniki wpływają w największym stopniu na rozwój zdolności przewozu ładunków w sektorze militarnym? W materiale wykorzystano szereg metod badawczych, wśród których wiodące były: analiza i synteza, kwerenda literatury przedmiotu, abstrahowanie oraz wnioskowanie. Jako metodę empiryczną wykorzystano metodę sondażu diagnostycznego przeprowadzonego techniką wywiadu eksperckiego. W artykule zidentyfikowano czynniki wpływające w największym stopniu na rozwój zdolności przewozu ładunków w sektorze militarnym, wskazując jednocześnie na potrzebę zacieśnienia podejmowanej w tym zakresie współpracy środowiska cywilnego i wojskowego. Zwrócono szczególną uwagę na czynniki mające newralgiczny wpływ na rozwój zdolności przewozowych w sektorze militarnym. Otrzymane wyniki pozwoliły wskazać, że rozwój zdolności do realizacji wojskowych przewozów ładunków stanowi priorytet w procesie doskonalenia podsystemu transportu i ruchu wojsk. Szczególną uwagę należy poświęcić przy tym na doskonalenie zdolności zarządczych, stanowiących kluczowy element dla zapewniania właściwych warunków do realizacji zadań przez siły zbrojne.

Słowa kluczowe: transport, logistyka wojskowa, ładunki