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Military logistics as a research field of management and quality sciences

Logistyka wojskowa jako pole badawcze nauk o zarządzaniu i jakości

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Abstract. The scope of cognition of military logistics encompasses a wide variety of problems, among which priority is given to issues relating to the management and achieved quality of logistics processes. Over the past several decades, this issue has received a lot of attention, and the result of ongoing, interdisciplinary research is a significant body of international and domestic publications. Their careful analysis makes it possible to identify the key research fields of military logistics, which are the main subject of cognition within the framework of ongoing scientific research. Moreover, that the scope of the publications issued, and the scientific problems addressed in them, were in the past, and still invariably remain in close correlation to the socio-military-economic situation.

The aim of the article is identification and assessment of the scope of contemporary cognition of military logistics in the area of management and quality sciences and bibliometric analysis of the phenomenon in question. The research problem taken up for solution was specified in the following form: what priority directions of scientific research dominate the development of military logistics in the area of management and quality sciences? A number of theoretical methods were used in the material, among which the leading ones were analysis and synthesis, abstraction and inference. The article identifies connections, similarities

and differences between the studied constructs, and formulates conclusions for further research using advanced methods of bibliometric analysis, i.e. the method of research profiling and methods that analyse the connections between publications.

Keywords: military logistics, bibliometric analysis, research trends, management, quality

Abstrakt. Zakres poznania logistyki wojskowej obejmuje szereg różnorodnych problemów, wśród których priorytetową rolę odgrywają kwestie odnoszące się do zarządzania i osiągniętej jakości procesów logistycznych. Na przestrzeni ostatnich kilkudziesięciu lat, problematyce tej poświęcono wiele uwagi, a wynikiem prowadzonych, interdyscyplinarnych badań naukowych jest znaczący zbiór międzynarodowych oraz krajowych publikacji. Ich uważna analiza pozwala zidentyfikować kluczowe pola badawcze logistyki wojskowej, które stanowią główny przedmiot poznania w ramach prowadzonych badań naukowych. Warto ponadto podkreślić, że zakres wydawanych publikacji, i podejmowanych w nich problemów naukowych był w przeszłości i wciąż niezmiennie pozostaje w ścisłej korelacji do sytuacji społeczno-militarno-gospodarczej, która miała miejsce w okresie bezpośrednio poprzedzającym ich opublikowanie.

Celem artykułu jest identyfikacja i ocena zakresu współczesnego poznania logistyki wojskowej w obszarze nauk o zarządzaniu i jakości oraz analiza bibliometryczna przedmiotowego zjawiska. Podjęty do rozwiązania problem badawczy został sprecyzowany w następującej postaci: jakie priorytetowe kierunki badań naukowych dominują w rozwoju logistyki wojskowej w obszarze nauk o zarządzaniu i jakości? W materiale wykorzystano szereg metod teoretycznych, wśród których wiodące były: analiza i synteza, abstrahowanie oraz wnioskowanie. Na podstawie przeprowadzonych analiz w artykule wskazano powiązania, podobieństwa i różnice pomiędzy badanymi konstruktami oraz sformułowano wnioski do dalszych badań z wykorzystaniem zaawansowanych metod analizy bibliometrycznej, tj. metody profilowania badawczego oraz metod analizujących powiązania pomiędzy publikacjami.

Słowa kluczowe: logistyka, siły zbrojne, interdyscyplinarność, zarządzanie, analiza bibliometryczna

Introduction

The development in the field of security and military logistic support has been the subject of many a scientific discipline for years. As indicated by the detailed nature of numerous publications devoted to this extremely important area, in which the armed forces function, questions related to the management of existing or acquired logistic potential, have attracted much attention. Hence, it is possible to forward the thesis that, the issue of management of all the basic functions is an inevitable element conditioning the ongoing optimization of logistic processes. These determine the tasks assigned to the armed forces, in any state the country finds itself. Widespread scientific research on the subject of military logistics result from its interdisciplinary character and leads to the fact that assumptions, content and methods of individual research permeate each other, forming a hard-to-unravel knot, yet full of interdependent features. Nevertheless, it is also evident that research areas dealing with the problem areas of the discipline of management and quality, are coming to the fore of scientific endeavour.

Consequently, we have chosen to study the subject of identification and evaluation of the range of contemporary knowledge about army logistics, in the area of management science and quality, as well as a bibliometric analysis of the phenomenon in question. The research problem that we have attempted to resolve can be expressed as follows: what major themes of scientific research are dominant in the

development of army logistics in the area of management and quality science? There are two main parts to the article on the above-mentioned topic. The first, referring to the identification of research areas of contemporary army logistics and the second, devoted to a bibliometric analysis related to the publication output of army logistics found in the SCOPUS database. It should also be emphasized that, due to the breadth and multi-dimensional character of the issues raised, the considerations presented hereby constitute cross-sectional material pointing unequivocally to the point of the studied problem.

Research areas of contemporary military logistics

In the research literature no general consensus has yet been reached on the definition of military logistics, in spite of numerous publications on logistics in the military environment. Nowadays, it is widely accepted, that the area of special exploration of military logistics is about theory and practice aimed at optimizing the management of organic and procured logistic resources, with particular focus on maximizing the efficiency of solutions used. The overriding objective of scientific research undertaken in the area of military logistics, therefore, appears to be precise identification of the challenges and expectations of each and every element of the logistic system. This is a prerequisite for the proper management of logistic potential used, in any state the country might be, for the benefit of military units and institutions.

Accordingly, research and development should be carried out in two main domains: the operational and technical. The operational domain is related to the necessity to conduct research with the goal of finding answers, as to what capabilities the logistics system should possess, the identification and responsibility of which should remain in the hands of combat support subdivisions. This makes it possible to make optimal use of the technical and material resources at hand, and helps to identify the capabilities, that need to be acquired. The technical domain relates to conducting research with the aim of acquiring tools, that will ensure carrying out effective logistic security in its technical and technological dimension, which will in turn allow for full exploitation of the army's operational capabilities. This particularly includes technologies used in operations such as: operating military equipment, procuring and storing food supplies, technical reconnaissance and evacuation, servicing and maintenance of military equipment, as well as new technologies enabling the acquisition of images showing logistic situations i.e. LCOP (Logistic Common Operation Picture). The pursuit of a holistic approach has always been related to the constant need to adapt optimal solutions to logistic problems in the field. Optimization means, selecting the best possible solution from all those available in a given

situation, from the perspective of a specific criterion and it is the overriding logistic task, in its theoretical and practical dimension (Jałowiec, 2020, p. 67).

Military logistics management, from the viewpoint of management theory, is a particular type of managerial activity designed to ensure the proper functioning of the army in times of war as well as in more peaceful times. It is designed to carry out specific tasks in order to meet the logistic needs of military units and institutions. Such understanding of the subject of management allows one to conclude that in the context of military logistics, it is functional as specific forces and resources of the military potential carry out the same tasks at different organizational levels (Pawlisiak, 2018, pp. 250-251).

In practical terms, it should be noted that the amount of logistic information in the preparatory and realization phases, on national and especially multi-national missions, is so large that implementing increasingly advanced ICT solutions is inevitable. Experts in this matter say, that one way to improve military logistics is to adopt an IT system. The potential benefits of such a strategy are among others: reducing the time-consuming introduction of such processes, improving the efficiency of logistic management and reducing logistics costs associated with the automation of logistic processes. This in turn, directly impacts the latter by improving the timeliness of delivery, reducing the volume of inventories or reducing the number of links in the logistics chain. However, we should bear in mind the fact that, computerizing the system increases the costs of operating it. Costs mean not only financial outlays, related to the purchase of hardware infrastructure or software but also, and perhaps primarily, outlays for the ongoing maintenance and update of already implemented IT systems and technologies in the area of logistics (Byleń, 2009, p. 137).

Contemporary trends in military logistics largely boil down to increasing interoperability through the use of the latest information and communication technologies. Inter-operability and even compatibility of two systems i.e. the civilian and the military, is expected to increase flexibility, sensitivity, as well as the efficiency of the response to the external environment and consequently, to increase the potential of the national logistics system (Kaźmierczak, 2019, p. 57). This is extremely important, as one of the key tasks of a logistician in uniform is to plan and coordinate interaction with allied troops while training at home and abroad as well as on missions. This will be facilitated, among other things, by the specialized NATO LOGFAS (Logistic Functional Area Services) system. Its purpose is to enable the interoperability of combined forces by standardizing and automating the data transfer process. This enables the management of logistical resources at every stage of both, joint exercises and military and crises response operations. NATO has made LOGFAS available to armies of allied countries and international commanders (Sendek, 2023).

Considering the basic assumptions, relationships and scope of modern military logistics in detail, a large number of experts in the literature unequivocally emphasize the urgent need to further develop complex predictive capabilities and to build new

network capabilities. This process shows that military logistics is giving primacy to the digital sphere. Research in the field of military logistics is moving from the stage of planning and optimization to interdisciplinary studies, that combine operations research, analytics, innovation management and new forms of organization inspired by networks, platforms and ecosystems (van Fenema, van Kampen, 2021,p.21). In this context it is also important to refer to technological and digital innovations and the modernization of supply chains in line with the idea of modern technology 4.0, the effects of which allow goods and related services to flow increasingly well over time (Minculete, 2021, p. 46). In addition, ongoing research aims to eliminate any disruptions in the functionality and integrity of military logistics chains, as they constitute a risk of strategic importance (Foltin, et al., 2022, pp. 3-8) for the performance of tasks by the armed forces in all states the country finds itself.

The above-mentioned areas of interest in military logistics represent a section of the multi-faceted sphere of military logistics security and support. Their common ground is the need to continuously optimize the available logistic potential, which is not possible without making use of the rules of management science and quality, developed over the years. In the framework of actions aimed to improve logistical processes in the military sector, it is achievements in organization and management theory that constitute the area of particular interest for scientific research, targeting the development and implementation of solutions which enable all the elements of the armed forces to function properly.

Publications in military logistics - bibliometric analysis

In the international literature, a wide variety of compact and periodical publications have been devoted to military logistics. These have increased in quantity after the Second World War, when authors, who had gained experience on the basis of the war, described individual areas related to security and logistic support of fighting troops. Since then, a number of publications on military logistics in its various dimensions, can be found in databases including the world's publication output.

Nowadays, it is possible to evaluate the publication output devoted to military logistics on the publication market thanks to bibliometrics, which, by means of quantitative methods, deals with the bibliographic unit, its role and significance in written communication and its relations with other bibliographic units, providing, the subject of research is an analysis of the literature (Pindlova, 1989 pp. 63-73). Another approach indicates that bibliometrics is the application of quantitative methods in which the unit of measurement is the bibliographic description or selected features thereof, used to analyze the structure of a collection of documents by discovering relationships between documents and establishing parameters that characterize collections of documents and their properties (Nowak, 2006, p. 19).

Bibliometrics is specifically a set of statistical methods used to study phenomena and processes involving documents, based on an analysis of bibliographic data and an interpretation of the results obtained. The SCOPUS database plays a key role in this respect, as it is widely recognized by the scientific community on the basis of the keywords indicated.

The point of bibliometric research is an analysis of the scientific literature, which makes it possible to assess the volume of scientific activity by use of mathematical and scientific methods. Thus, bibliometric analysis boils down to a search for regularities in the structure of scientific output in a given field and the identification of a pattern characterizing a selected set of publications. All bibliometric methods can be divided into three groups of research methods: analysis of the number of publications over time, used to assess scientific activity; citation analysis and citation networks, used to assess the impact of the unit under study on the development and diffusion of knowledge in the field; co-word analysis, co-classification analysis and co-authorship analysis, used to identify research trends in the area studied (Teixeira, Sequeira, 2009, p. 3).

The article uses three bibliographic methods with four bibliometric indicators, i.e. the number of publications, the number of citations of publications in a specific chronology, the number of publications in specific types of documents, the number of publications by country, and the method of co-occurrence of words (*co-word analysis*) to identify the main research themes in the area analysed. *Co-word analysis*, which originates from the sociological actor- theory network (ATN), assumes that regularly occurring phraseological compounds or words occurring in the text under study, may turn out to be relevant theoretical formulations in a given research discipline. Using the technique of co-occurrence of words, the space between two terms is analyzed, whereby term, means a sequence of words. The basis for conducting a word co-occurrence analysis is a file containing the implemented terms from all records of the mapped research field, including the title, the abstract and keywords.

The procedure of extracting terms takes three stages and its language of analysis is English (van Eck, Waltman, 2011, p. 3). In the first stage, nouns and adjectives in the singular were extracted from the source texts using the Vosviewer software. In the second stage, the strength of collocations for phrases was examined i.e. the frequency the entire phrase occurred was compared with the number of appearances in the text of the phrase without the first word, and with the frequency only the first word of the phrase occurred. Thus, the hypothesis of whether the analyzed phrase occurs more frequently than we might expect was statistically verified, on the basis of how frequent the first and second word occur. In the final step, the meaningfulness of the phrases was examined, i.e. the extent to which the term *military logistics* represents the research area.

In the study conducted, on the basis of preliminary analyses the scope of the research was limited to the term *military logistics*, supplemented by *military supply*

chain and military transportation. All types of documents published after 1965 were analyzed for bibliographic data (Fig. 1).

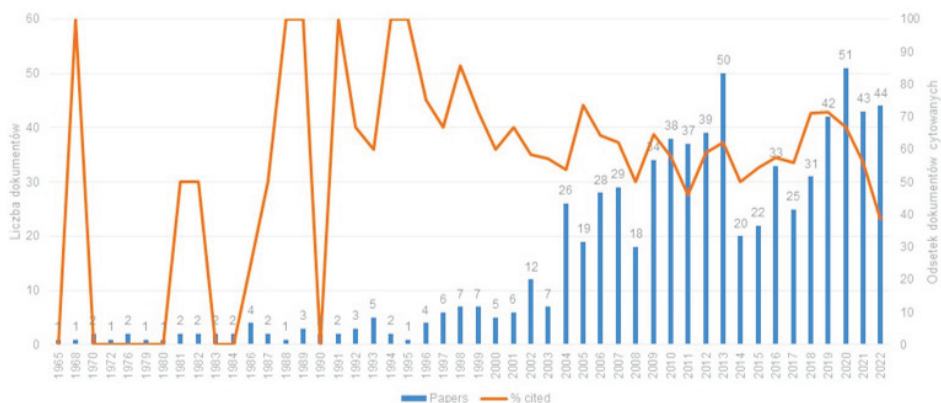


Fig. 1. Number of papers and percentage of papers cited between 1963-2022 in the SCOPUS database on military logistics

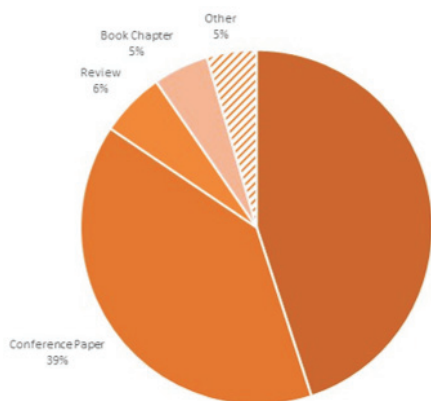
Source: Own study

As can be seen in Figure 1, the highest number of publications on military logistics was registered in the SCOPUS database in 2020 (51) and 2013 (50). It is also worth noting that there was a clear growth index, in terms of quantity, of the keyword studied after 2004. At the time, at least 18 publications were entered into the SCOPUS database each year (2008), which in fact, should be seen as extremely modest compared to all the indices registered in the database. It should also be noted, that approximately 50% of the indicated publications were cited by other authors.

While making a detailed analysis of the publication output concerning military logistics present in the SCOPUS database, it is worth pointing out the nature of the publications. The most numerous group consists of scientific articles (326 items, which constitutes 45% of all publications) and scientific publications included in post-conference publications (286 items) which constitute 39% of all publications). A detailed distribution of the types of documents on military logistics in the SCOPUS dataset is provided in Figure 2.

Cross-sectional information characterizing the publication output devoted to military logistics is provided by an analysis of publications by the country where they were published. The clear leaders in this respect are the USA with 214 publications of a total of 779, which constitutes almost 30%, and China with 169 publications (approx. 22%). Compared to this, the publications output of Polish authors is extremely modest, accounting for only around 1.5% of all papers published. It is worth noting, however, that in the past 5 years papers published by Polish authors have been contributing to international reference databases. A detailed distribution

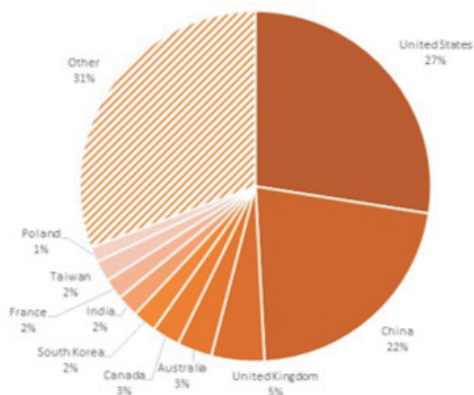
of the types of documents on military logistics by country implemented from the SCOPUS database is presented in Figure 3.



Lp.	Typ dokumentu	Liczba publikacji
1	Article	326
2	Conference Paper	286
3	Review	43
4	Book Chapter	37
5	Other	33

Fig. 2. Types of documents included in the SCOPUS database between 1963-2022 on military logistics

Source: Own study



Lp.	Publikacje wg. państw	Liczba dokumentów
1	United States	214
2	China	169
3	United Kingdom	38
4	Australia	25
5	Canada	20
6	South Korea	17
7	India	16
8	France	15
9	Taiwan	15
10	Poland	11
	Other	239

Fig. 3. Publications by country included in the SCOPUS database from 1963 to 2022 on military logistics

Source: Own study

scientific centers published in the USA and China in the creation of military logistic thought. Moreover, it reflects the different approach to research relating to logistic problems in the military sector compared to the civil sphere, taking into account interdependent elements and military challenges on a micro and macro scale.

Summarizing the bibliometric analysis of the publication output concerning military logistics presented in this part of the paper, it should be emphasized that only the most important dimensions of this extremely complex research process were referred to. The scope of the present material, in accordance with the research assumptions adopted, did not allow for an extended bibliometric analysis, but made it possible to identify its particularity and to establish the interdependence of research conducted in the research community dedicated to the issues of military logistics. Meanwhile, it should be emphasized that the language of bibliometric analysis in the software used, was English, which means that significant publications published in other languages, including Polish, are not being taken into account in this type of analysis. Due to the volume of this article, the bibliometric analysis used basic bibliometric indices, thus omitting such methods /indices as H or M (Hirsch, 2005), G (Egghe, 2006), unitary H (Batista, Campiteli, Kinouchi, 2006), generalized H (Sidiropoulos, Katsaros, Manolopoulos, 2007). The analysis should therefore, be considered as preliminary, requiring further research that are suitable to the problem fields of the discipline of *management science* and *quality*. It would be advisable to consider conducting an analogous analysis of an interdisciplinary kind, i.e. using bibliometric records from two disciplines: security science and management and quality science, including publications in Polish.

Conclusions

The results obtained in the research process lead to the following general conclusions:

1. The greatest impact on the development of military logistics in the twentieth and twenty first centuries, in terms of publication activity, has been the experience resulting from global and local armed conflicts.
2. The relationships between the different areas of military logistics are a source of knowledge, particularly in the framework of management and quality science and security sciences.
3. Military logistics proves to be most closely related to problems resulting from physical movement of goods between the various links in military supply chains, that operate on a national and international/ allied level.
4. Quality issues are an important area of research in all spheres of military logistics, particularly, in automatic identification, transport and process flows of military supply chains.

5. The publication output of the Polish scientific community conducting research in the area of military logistics appears to be very modest, against the background of the materials found in global databases, in which the USA and China stand out as leaders.
6. In conclusion, it should be stressed that conducting research in the field of military logistics in its international form, is extremely important due to the specific nature of the tasks performed by the subjects of military logistics systems. Indeed, recent developments have highlighted the relevance and significance of scientific work intended to improve logistics processes taking place in an extremely complex and dynamic international security environment.

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