THE POTENTIAL OF A MILITARY LOGISTICS SYSTEM

ABSTRACT

The potential of a military logistics system is an important element of the defence potential. It affects the level of defence capabilities to a large extent. Its size, distribution, and creation should be adapted to the needs of the armed forces. The issue of shaping the military potential of a logistics system is an important theoretical and practical problem. The article presents the concept, categories, and distribution of the military potential of a logistics system.

Key words
security, military logistics, potential, deployment

INTRODUCTION

Potential is a term that is widely used both by logistics and almost all other sciences. The term is used in economic and exact sciences, security sciences, and systematic sciences like IT, system engineering, or operations research. The potential is also a systematic feature of a military logistics system. As a result of the attractiveness, universalism and ubiquity of various categories of potentials in theoretical discourse, as well as their unquestionable position in applied sciences and practical studies, the potential is now considered as a synonym of a certain theory that is willingly used in many fields of science and technology, as well as security studies. The theory of potential includes a diversified system of terms and a complex mathematical apparatus. The main reason for the creation of such a theory was the need to express certain intuitionally acceptable values, like power, force, capacity, capability, etc., in a measurable way.
The purpose of this article is to define the military potential of a logistics system and a category of such a system and to make an attempt of assessing its deployment in Poland.

MEANING OF THE POTENTIAL OF A MILITARY LOGISTICS SYSTEM

The concept of potential is often used in the field of business logistics [7,8,9]. The authors most often present proprietary methodologies for the assessment of logistic systems of enterprises, which are usually not applicable to the assessment of the potential of military logistics systems. In the literature on military logistics, authors often use such terms like [2,3,5] potential, resources, reserves, inventories as synonyms. This is terminology which is used colloquially and reflects certain categories in the scientific discipline of logistics, however without precise definition. Seemingly, these terms, when used, are clear and understandable. Therefore, as a rule, their essence does not need to be precisely defined. However, certain doubts appear when the terms and their interrelations are analysed more deeply.

There are many definitions of logistics potential. However, the analysis indicates that potential, resources and capabilities are often treated as synonyms. The definition of potential from the Polish dictionary\(^1\) is an example: “... a set of capabilities, power, generation capacity of something; efficiency, capacity, capability, in particular, of a state in any, e.g. economic or military, field.”

In accordance with the same source, a resource is “a certain quantity of something collected to be used in future”. In turn, capability means “an ability of something of operating and achieving some effects which becomes apparent in favourable conditions”. And the ability is “fitness for something”.

The analysis of the above terms indicates that the potential is the broadest term because it also includes resource management methods. Thus, we can draw a conclusion that the same quantity of resources in two military logistics systems does not need to mean that they have the same potential. And another conclusion is that forms of resources are often confused with logistic processes, i.e. actions. Thus, resources are just any type of capabilities of action and an element of the logistics potential. For example, these can be capabilities of performing processes connected with supplies for armed forces, repairing military equipment, or providing medical treatment to soldiers.

Resources of military logistics systems may be broken down into categories:
- physical resources, including a technology acquired by a logistic facility, buildings, machines and equipment, as well as capabilities of supplementing such physical resources;

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- human resources, including: knowledge, capability, skills, health, approaches, values and motivation of soldiers and military staff, a network of human relationships and commanding and management skills of superiors;
- organisational resources, including both formal and informal planning systems, techniques of reporting, control, remuneration and motivation, activity coordination methods and informal relations established both within the logistic facility, as well as with forces it serves.

Logistics resources may also include information resources. They combine other resources of armed forces and let choose and use them in the most effective way. The potential of a military logistics system is connected with such categories as inventories and reserves. Inventories and reserves mainly include tangible resources as their parts. In accordance with the Polish dictionary, an inventory is a certain quantity of something, e.g. some products, raw materials, money, collected to be stored for a certain period for future use. In turn, a reserve is an inventory of something usually prepared for an urgent need.

Relations between these categories: potential, resources, inventories and reserves are presented in Chart 1.

Analysing and generalising the above terms of the logistics potential, the logistics potential $P_L$ may be defined as a function of logistics capabilities $M_L(t)$.

$$P_L = f \left[ M_L(t) \right] \quad (1)$$

Logistics capabilities constitute a dynamic value that is variable in time. They can only be measured at certain moments under strictly determined conditions and at strictly determined limitations.

Chart 1. Relations between the terms: potential, resources, reserves and inventories

CATEGORIES OF THE POTENTIAL OF A MILITARY LOGISTICS SYSTEM

Analysing definitions of the logistic potential, it must be noted that basic categories of such a potential are: human potential $P_L(t)$, technical potential $P_T(t)$, material potential $P_M(t)$ and management potential $P_Z(t)$.

$$P_L = P_L(t) \cup P_T(t) \cup P_M(t) \cup P_Z(t)$$  \hspace{1cm} (2)

The human potential $P_L(t)$ means all psychical and physical capabilities of people taking part in logistics processes. In the quantitative approach, the human potential is sometimes considered solely as a number of logistics personnel, which is a great simplification. The human potential is practically and commonly determined by a logistics readiness index.

The technical potential $P_T(t)$ reflects all capabilities of technical means used in logistics processes. Technical means include technical equipment and logistics infrastructure.

The material potential $P_M(t)$ reflects all inventories of materials that are necessary to carry out logistics processes. In terms of quantities, the material potential should be defined as the sum of potential of all types of supplies used in logistics processes.

The management potential $P_Z(t)$ should be defined as all planning, organisational and control capabilities of human teams involved in logistics processes. As a rule, this means specialised management authorities, i.e. management staff and planning authorities.

Given the functional criterion, the potential of a military logistics system may be broken down into: the potential of material security $P_{ZM}(t)$, the potential of technical security $P_{ZT}(t)$, the potential of transport security $P_T(t)$, the potential of medical security $P_M(t)$, the potential of military infrastructure $P_{IW}(t)$, the potential of management $P_K(t)$:

$$P_L = \{[P_{ZM}(t)], [P_{ZT}(t)], [P_T(t)], [P_M(t)], [P_{IW}(t)], [P_K(t)]\}$$  \hspace{1cm} (3)

The aforementioned potential of a military logistics system can be called a general potential and a degree of its use can be called a specific potential of a logistics system $P^K_L$.

The specific potential of a military logistics system is dependent on a degree of its use in defined conditions. Thus, this is a part of general potential dependent on the impact of external factors:

$$P^K_L = K \cdot P_L$$  \hspace{1cm} (4)

where: $K$ – means a coefficient of a total impact of external factors, which, in turn, constitutes a certain function of coefficients of impact of various conditions.
\[ K = f (k_1, k_2, ...k_i) \]  

where: \( k_1, k_2, ...k_i \) mean single coefficients of impact of each external factor, e.g. weather, year season, road condition, etc.

The potential of a military logistics system may be analysed on the basis of a scale of a given military organisation (e.g. subunit, unit of a tactical unit, operating unit, types of armed forces, the whole armed forces), or a scale of a given area, e.g. continent, state territory, region. This is a function of logistics infrastructure of the defined area and a necessary condition for the operation of military logistics.

**CHARACTERISTICS AND DEPLOYMENT OF THE POTENTIAL OF A MILITARY LOGISTICS SYSTEM**

**Characteristics of the potential of a military logistics system**

Means of the potential of a logistics military system are stationary infrastructure facilities strengthened with mobile military equipment and state base. These are warehouses, storage yards, repair shops, hospitals, munitions and materials on means of transport, movable repair shops, field hospitals.

In the systematic approach to military logistics, logistics infrastructure is made of three elements:

− nodal infrastructure made of separate facilities used to provide stationary services to freight (regional logistics bases, warehouses, storehouses of munitions, or materials), technical workshops, hospitals;

− linear infrastructure made of a transport network of special importance for defence, used for military transport, including the transport of munitions and materials;

− communications (IT) infrastructure made of means of transmission, data exchange standards and data flow protection measures.

Specific properties of the infrastructure of a military logistics system are as follows:

− a long period of use and a great degree of inertia of systems that are permanently connected with a given region;

− investment expenses for the development of the infrastructure of military logistics system do not generate direct profits;

− they may provide services not only to the army, but to the community, as well, e.g. military outpatients clinics and hospitals;
they usually constitute nodal elements, e.g. storehouses, repair workshops, and relationships between them constitute linear elements of the technical infrastructure of a state;

connections between facilities that form a logistics network.

Each element of the infrastructure is made of:

− elements used to carry out core activities and elements strictly connected with such activities;

− soldiers and employees of the army who perform core and administrative activities, and maintain the facility;

− equipment for core activities and facility maintenance;

− an organisational and legal system that provides for principles for the operation of forces and meeting their needs;

− a defence and protection system of a logistics facility.

Nodal infrastructure facilities connected by linear elements form logistics networks. While constructing logistics networks, it is necessary to choose logistics infrastructure facilities from the existing ones, define the location of and connections between new ones based on the following factors:

− expected directions, size of military hazards and potential depth of breaking and entering by enemies;

− operational grouping of own forces, expected scenario of military actions resulting from strategic planning and definition of a shape of logistic capabilities in a long run;

− possible destructive impact of an enemy on logistics infrastructure facilities and expected losses;

− degree of sensitivity of logistics infrastructure of the enemy’s impact and infrastructure capability to recover the balance;

− protective distances from other defence infrastructure facilities that are subject to particular hazards;

− maintenance of reserves of logistics infrastructure facilities.

The defined territorial logistics potential will determine the efficiency of the military logistics system. That is why the way it is shaped is very important. The deployment of the logistics potential for defence needs should be correlated with a deployment system, e.g. in the region, country and then the EU and NATO.

To define infrastructure development directions in defined areas in terms of the flow of streams of tangible goods, it is necessary to assess their logistics needs and the capabilities of the logistics infrastructure. The accuracy of identification is mostly dependent on the quality of a model applied to balance needs and capabilities given the saturation of the territory with the logistics potential.
Such a model may be constructed by dividing the territory into certain areas and characterising such areas on the basis of a vector of temporary logistics needs:

\[ N^k_i(t) = \{n^k_1(t), n^k_2(t), \ldots, n^k_i(t), \ldots, n^k_n(t)\} \]  \hspace{1cm} (6)

where: \( n^k_i(t) \) – expected demand of forces for \( i \) type of logistics needs at \( t \) in \( k \) area and a vector of temporary logistics capabilities

\[ M^k_i = \{m^k_1(t), m^k_2(t), \ldots, m^k_i(t), \ldots, m^k_n(t)\} \]  \hspace{1cm} (7)

where: \( m^k_i(t) \) – expected capabilities of the logistics infrastructure (logistics potential) at \( t \) in \( k \) area.

The stationary potential of defined areas may be strengthened with mobile potential. As regards military logistics, this is a rule, and a degree of strengthening is dependent on the organisational level of forces. At the tactical level, a degree to which the stationary potential is used in military actions is usually smaller than at the operational and strategic levels.

At the tactical level:

\[ \frac{P^M_L(t)}{P^S_L(t)} > 1 \]  \hspace{1cm} (8)

where: \( P^M_L(t) \) – mobile logistics potential, \( P^S_L(t) \) – stationary logistics potential, and at the operational and strategic levels:

\[ \frac{P^M_L(t)}{P^S_L(t)} < 1 \]  \hspace{1cm} (9)

**Deployment of the potential of a military logistics system**

Given the open character of this publication, the deployment, analysis and assessment are based on warehouses of propellants and lubricants, as well as technical workshops.

Warehouses of propellants and lubricants are located in the following places:

Nowy Glinnik, Powidz, Poznań, Radom, Siemirowice, and Świdwin, and warehouses of ship fuel in: Świnoujście and Gdynia.

The mobile potential is made of procurement units of logistics brigades, transport battalions of newly established logistics regiments, brigades and regiments of types of forces.

The stationary repair potential is made of: regional technical workshops (RWT) in Grudziądz, Bydgoszcz, Nowy Dwór Mazowiecki, Żurawica, Rzeszów/Lublin, and Jastrzębie Śląskie, technical workshops (WT) in Łomża, Piława, Krosno Odrzańskie, and Oleśnica, and air and sea technology workshops: Aircraft Technology Workshop (WTL) in Toruń, Aircraft Armament and Electronics Workshop (WUiEL) in Nowy Dwór Mazowiecki, Field Aircraft Workshops (PWL) in Bydgoszcz and Radom, Sea Technology workshop in Gdynia.

The mobile potential of technical security facilities is made of evacuation battalions located in: Czarne and Oleśnica and repair battalions in: Czarne, Elbląg, Giżycko, Kołobrzeg, Opole, and Żagań.

**ASSESSMENT OF THE DEPLOYMENT OF THE POTENTIAL OF A MILITARY LOGISTICS SYSTEM**

While shaping a rational deployment structure of logistics infrastructure, it is necessary, in particular, to take into account the possibility of its use during military actions. Taking the above factors into consideration, the territorial location of the logistics potential in Poland presented in Chart 2 can be assumed. In the assessment of the location of the logistics potential of Poland, it is necessary to take into consideration, in particular, expected directions, the size of military hazards and a potential depth of breaking and entering by enemies, a potential destructive impact of an enemy on logistics infrastructure elements, and expected losses, including the operational grouping of own forces, an expected scenario of military actions resulting from strategic planning and the definition of a shape of logistic capabilities in a long run.

The territory of the country can be divided into three zones:

I. from the north-east border to Line A – Szczecin – Grudziądz – Włodawa;

II. from Line A to Line B- Kostrzyń – Gorzów Wlkp. – Kielce – Przemyśl;

III. from Line B to the south-west border.

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The location of warehouses of propellants and lubricants in Poland is as follows:

- **Zone I**: warehouses in Cybowo, Dębogórze, Gardeja, Maksymilianowo, Marcinkowo, aircraft and airport warehouses in Darłowo, Malbork, Siemirowice, Świdwin, and ship fuel warehouses in Gdynia and Świnoujście;
- **Zone II**: warehouses in Dolaszewo, Maksymilianowo, Puszcza Mariańska and aircraft and airport warehouses in Dęblin, Inowrocław, Leżnica, Łask, Nowy Glinnik, Mińsk Mazowiecki, Powidz, Poznań, Radom;
- **Zone III**: warehouses in Niedźwiedź, Porażyn, Radnica, Wędrzyn, and a warehouse in Kraków.
The author realizes, that assessing the location of warehouses of propellants and lubricants in terms of their number is a great simplification. As mentioned above, the potential should be assessed not only in terms of the location of warehouses, types of propellants and lubricants stored, but in terms of the capacity of warehouses and a degree to which they are filled as well. However, given the open character of this publication, such an assessment is not possible. In the author’s opinion, the assessment of the location of warehouses of propellants and lubricants in particular zones, given the number, introduces the essence of the problem to an approximate extent. In Zone I, there are: 42% of warehouses, 27% of aircraft and airport warehouses and 100% of ship fuel warehouses. In turn, in Zone II there are 25% of warehouses and 64% of aircraft and airport warehouses. And in Zone III there are 33% of warehouses and 7% of aircraft and airport warehouses.

The location of stationary technical workshops in Poland is as follows:

- Zone I: Regional Technical Workshop (RWT) in Grudziądz, Technical Workshop (WT) in Łomża and Sea Technology Workshop in Gdynia;
- Zone II: regional technical workshops (RWT) in Bydgoszcz, Nowy Dwór Mazowiecki and Lublin/Rzeszów, Technical Workshop (WT) in Piła, Aircraft Technology Workshop (WTL) in Toruń, Aircraft Armament and Technology Workshop (WUiEL) in Nowy Dwór Mazowiecki, and Field Aircraft Workshops (PWL) in Bydgoszcz and Radom;
- Zone III: regional technical workshops (RWT) in Jastrzębie Śląskie, Rzeszów/Lublin, Żurawica and technical workshops (WT) in Krosno Odrzańskie and Oleśnica.

In Zone I, there are 20% land technology repair workshops (RWT and WT), 0% of aircraft technology repair workshops and 100% of sea technology repair workshops. In turn, in Zone II there are 35% of land technology repair workshops (RWT and WT) and 100% of aircraft technology repair workshops. And, in Zone III there are 45% of land technology repair workshops (RWT and WT).

The analysis reflects an excessive number of such workshops in Zone I, where they may be particularly exposed to destruction or immobilization. This means that logistics facilities of forces operating in Zone I should be mainly based on the mobile potential strengthened with the stationary potential, in Zone II on the stationary potential strengthened with the mobile potential, and in Zone III on potential that will be capable of performing the duties of the logistics facilities.

Depending on location, stationary infrastructure facilities and mobile logistics units are exposed to destruction or immobilization to a different extent, and to a decrease in their logistics potential to the same extent. The risk of the loss of potential is depicted in Table 1.
The risk may be treated as the loss of logistics potential depending on the location zone.

Table 1. Risk of loss of logistics potential

<table>
<thead>
<tr>
<th>Consequences of hazards</th>
<th>Very significant</th>
<th>0</th>
<th>0.33</th>
<th>0.66</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Significant</td>
<td>0.66</td>
<td>0</td>
<td>0.218</td>
<td>0.435</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>0.33</td>
<td>0</td>
<td>0.111</td>
<td>0.218</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Probability of occurrence

<table>
<thead>
<tr>
<th>Probability of occurrence</th>
<th>Unlikely</th>
<th>Small</th>
<th>Big</th>
<th>Very big</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.33</td>
<td>0.66</td>
<td>1.0</td>
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Stationary infrastructure facilities and mobile logistics units in Zone I are exposed to destruction or immobilization mainly as a result of the use of artillery, rocket artillery systems, missile systems and air forces, in Zone II rocket artillery systems, missile systems and air forces, and in Zone III missile systems and air forces.

Taking into account the analysis, including expected directions, the size of military hazards and a potential depth of breaking and entering by enemies, a potential destructive impact of an enemy on logistics infrastructure elements, and expected losses, including the operational grouping of own forces, an expected scenario of military actions resulting from strategic planning and the definition of a shape of logistic capabilities in a long run, we should aim at deploying the stationary potential of logistics infrastructure in Poland as follows: Zone I – 10%, Zone II – 60%, and Zone III – 30%.

The potential of military logistics systems is dynamic. The location and size of the potential change and should be adjusted to needs of the armed forces on a case-by-case basis. Effective military actions are dependent on the defined level of the logistics potential.
Given the opinions of American specialists on the army, as regards the military logistics system it can be assumed that if the potential of such a system is:

- 90 – 100%, there is a small risk of incomplete performance;
- 70 – 89%, there will be small limitations to performance;
- 60 – 69%, there will be significant limitations to performance;
- 59% and less, the task is likely not to be performed at all.

The elimination (destruction, damage, seizure) of logistics infrastructure facilities by an enemy and the performance of tasks connected with the logistics security of forces may result, in a short time, in a substantial reduction of the logistics potential and the efficiency of the forces. Assuming that the beginning potential of a military logistics system is 100%, after time t\text{g} it may reach the limit of 60%, where the system may be incapable of performing tasks related to the logistics security of forces. Thus, it will be necessary to increase the potential by the use of domestic base facilities, support allies or import.

**SUMMARY**

The potential of a logistics system is its property that characterises capabilities of system operation. The logistics security of the armed forces means the preparation, rational use and maintenance of an adequately deployed logistics potential for the purpose of military training and effective military actions. This is a complex and costly issue, which is, however, very important for the defence system of a country.

**BIBLIOGRAPHY**


