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WDRAŻANIE NOWYCH TECHNOLOGII W CELU OCHRONY KONWOJÓW I URZĄDZEŃ LOGISTYCZNYCH REALIZUJĄCYCH ZADANIA W SPECYFICZNYCH ŚRODOWISKACH WALKI

THE IMPLEMENTATION OF NEW TECHNOLOGIES IN FORCE PROTECTION FOR CONVOYS AND LOGISTIC POINTS IN SPECIFIC COMBAT ENVIRONMENTS

Głównym celem zabezpieczenia logistycznego wojsk realizujących zadania w specyficznych środowiskach walki jest zapewnienie ciągłości zaopatrywania oraz rozpoznanie, ewakuacja i naprawa uszkodzonego sprzętu wojskowego. W zależności od rodzaju środowiska, w jakim prowadzone są działania występują pewne problemy związane z dostarczeniem żołnierzom odpowiedniego rodzaju środków zaopatrzenia, we właściwej ilości, czasie oraz w nakazane miejsce. Ochrona i obrona konwojów oraz urządzeń logistycznych w specyficznych środowiskach walki staje się istotnym problemem dla dowódców pododdziałów logistycznych. Skuteczność zabezpieczenia logistycznego wojsk realizujących zadania w specyficznych środowiskach walki można zwiększyć, wykorzystując nowe technologie uzupełniające standardowe rozwiązania w zakresie ochrony i obrony konwojów oraz urządzeń logistycznych.

Słowa kluczowe: *zabezpieczenie logistyczne wojsk, specyficzne środowisko walki, nowe technologie, bezzalagowe statki powietrzne, ochrona wojsk, wojskowy łańcuch dostaw*

The main objective of the combat logistic support in a specific battle environment is to maintain a continuous required supply and to recover/evacuate damaged equipment. Depending on the type of environment, there are some problems with providing troops with the supply which should be of proper sort and amount and fulfil the troops' needs at right time and in the right place. The force protection of supply convoys and logistic points in a specific battle environment becomes a significant problem for the commanders of logistic troops. The effectiveness of combat logistic support in a specific battle environment can

be augmented by using new technologies complementing standard solutions in the field of force protection of supply convoys and logistic points.

Keywords: *combat service support, specific battle environment, new technologies, unmanned aerial vehicles, force protection, military supply chain*

Introduction

The logistic support of the troops performing in specific environments was and still is a significant challenge for planners and logistic troops. Such problems occur due to the specifics of particular environments which determine the tasks for the troops and their order of battle. The contemporary logistic potential of tactical level should be properly protected. However the lack of an integrant force protection in the structure of logistic troops imposes the need to find alternative solutions in terms of protecting the logistic points and convoys which are the elements of supply chain. One of such solution is the use of unmanned aerial vehicles (UAV). Some determinants are consequential to specific battle environments typical for Polish territory. Taking these determinants into consideration it is possible to use UAVs for a protection of logistic points and convoys, which could increase the effectiveness and effectivity of combat logistic support.

The characteristics of specific battle environments

The combat logistic support performed by logistic troops at different levels in specific battle environments is determined by several factors which include:

- terrain covering and landform, - soil type;
- surface waters, groundwater, amount and capacity of water sources, condition of hydraulic engineering devices;
- density and condition of road network, structure of urbanized areas;
- local climate of a particular region in each season of the year (precipitation, temperature).

The qualitative and quantitative composition of main terrain elements is crucial to classify its physical-geographical character and to describe its tactical characteristics. In Poland there have been distinguished following terrain types:

- plain (e.g. Mazovia Lowland, Great Valleys Land);
- hilly (e.g. Kaszuby, Suwalskie Lake District);
- corrugated (e.g. Podole, Roztocze);
- mountainous (e.g. Świętokrzyskie Mountains, Carpathians);
- alpine (Tatra Mountains).

The type of a tactical operation (defense, attack, delay, and movement operations) should be always taken into account to identify the correlation between ter-

rain and probability of winning a battle. The terrain factor importance will depend also on tactical situation along with the equipment used in a battle (Elak, 2013, p. 33). It may happen that in particular situations some terrain elements will help to conduct the defense operations, while on assault actions it can have adverse influence. As for the logisticians, the terrain accessibility is the main tactical criteria for a particular terrain classification. When planning an operation (regardless if in the country or abroad) it should be taken into account that such operation might be held in specific environments which may have significant impact on preparing and performing actions. It is due to the fact that these specific environments are characterized by different landforms, land covering, climate conditions and different time of day.

A terrain meets the criteria of so called normal conditions when it is plain or cut with hills which are not higher than 50 m (of relative height) and their slopes are easily passable for essential combat equipment (most of the terrain is of "GO" type). Moreover, the terrain covering with i.e. forests, swamps, rivers, lakes and urbanized areas does not exceed 50% of total terrain acreage).

The climate conditions of such terrain fit in following limits (Smyk, 2004, p. 61):

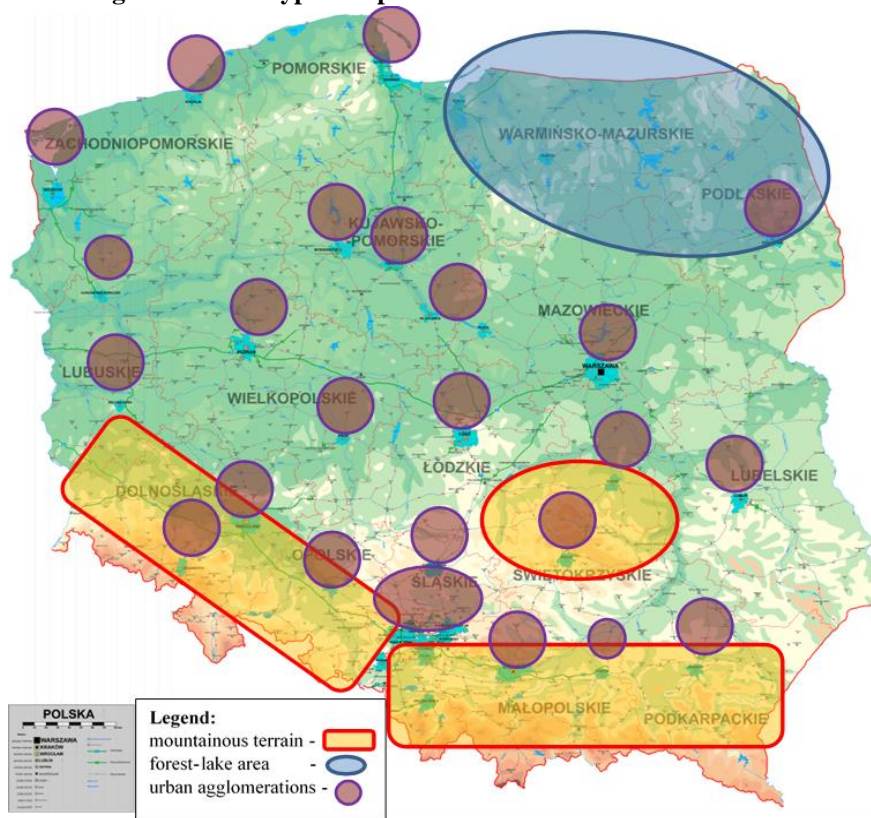
- visibility is not less than 4 km;
- air temperature is higher than -5°C but does not exceed $+30^{\circ}\text{C}$;
- thickness of snow cover does not exceed 15 cm.

A terrain can be called specific when its physical character and climate does not fit in the limits mentioned above. Regarding Polish local conditions there can be identified tactical operations conducted: in urbanized area, in a mountainous terrain, in a woody terrain (or woody with lakes), in a seashore terrain, in winter, and in the night (limited visibility conditions) (Jasiniewski, 1994, p. 6).

The specific battle environments determine the order of battle and the manner operation is conducted, which influences the location and performance of logistic troops and logistic points. In such situation the logistic troops have to take actions in order to overcome the encountered difficulties.

Analyzing the factors mentioned above following should be taken into consideration:

- feasibility (accessibility) of troops' layout and positioning the logistic points;
- maintaining good work conditions for the logistic points;
- development level and setup of road network (lines of communication);
- ways of preparation the equipment to move in a rough terrain;
- possibilities of fetching the water;
- manner of supply, along with the way of medical evacuation and damaged equipment recovery/evacuation;
- scope of auxiliary specific services and household (billeting) services;
- scope and manner of force protection arrangements for logistic convoys and logistic points.

Figure 1. Three types of specific battle environments in Poland

Source: https://pl.wikipedia.org/wiki/Miasta_w_Polsce, [01.04.2017 r.].

The planning, organizing and performing of combat logistic support in specific environments significantly differs from this performed in normal conditions.

A **mountainous terrain** often poses significant difficulties for combat logistic support and for force protection of logistic convoys and logistic points. Due to varied landform and land covering there is no well-developed road network (lines of communication). These roads are frequently quite narrow, steep and winding. It hampers the organization of supply system, medical evacuation, and equipment recovery/evacuation. The tough mountainous climate conditions (long winters, frequent and intense precipitations, low temperatures, strong winds, frequent mists) may as well pose some problems which should be taken into account. These circumstances hamper the transport (slippery roads with ice-covered surface and with a thick layer of snow) and have adverse impact on living conditions of forces. The high amplitude of temperatures imposes the need to additionally provide the troops with special warm clothes, frostbite prevention means, sunglasses, etc. The

force protection issues in such terrain require exceptional approach, because this type of terrain helps the enemy to conduct diversionary operations.

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A woody terrain (or a **woody terrain with lakes**) poses particular problems with force protection of logistic convoys and logistic points established by the logistic troops. The main causes of such difficulties are: fire hazard, high risk of being detected by the enemy for logistic points positioned in the forest, and potential enemy's diversionary operations. Therefore it seems to be reasonable to avoid establishing the logistic points and organizing the logistic convoys in large forests. The use of forest roads without proper force protection should be avoided as well. Additionally it should be taken into account that there might be some difficulties with using the forest roads, especially during heavy rains and snow.

An **urbanized area** generally helps to organize and to conduct the combat logistic support. In such terrain the lines of communication and their network are high developed. There are also numerous warehouses with fuel, food, medicines and other products. On the whole there is no problem with localization and use of a local technical, medical and billet infrastructure. Using all the resources mentioned above augments the combat logistic support processes. The disadvantages of performing operations in urbanized area are: high fire hazard and road obstructions

after bombing (which hamper or completely block the supply, medical evacuation, and damage equipment evacuation).

Generally conducting an operation in a **seashore terrain** does not significantly differ in terms of logistic support from operating in normal conditions. The force protection of logistic troops in this case is crucial because of some threats, such as: naval assault, airborne landing, air attack and diversionary-reconnaissance groups.

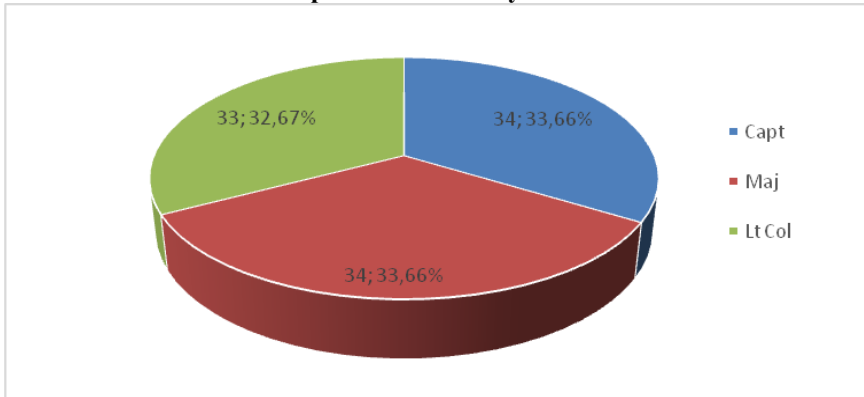
Winter is considered particularly difficult for troops performing in our climate zone. In this case the organization and performing combat logistic support requires an uncommon effort. It is mainly due to the tough (sometimes extremely tough) weather conditions which have an adverse impact on support and evacuation tasks performance. The low temperatures increase the equipment damages level, increase the fuel consumption, and may cause health problems among troops. Thus the cold imposes: additional warm clothes supply, food calorific value increase, provide of the heating systems for troops. Many of these actions have to be conducted in the night (in winter daytime is short) and in poor visibility conditions (blizzards, mists, etc.).

There are some advantages but also some disadvantages of the operations conducted in the **night**. One of the advantages is that performing in a limited visibility has a beneficial impact on concealment issues, which augments the security. On the other hand the main disadvantage for logisticians is that many logistic tasks become more difficult. There may also occur some problems with a spatial orientation during movement and layout of logistic points. The evacuation and supply might be harder as well.

The analysis above show that the group of factors having the most significant impact on combat logistic support includes: tactical factors, logistic factors, terrain and weather factors, and organizational factors. The first four factors concern all forces, while the organizational factors are strongly related to the specifics of logistic operations conducted by logistic troops which presently have no own force protection. There is no doubt that the knowledge about mentioned conditions is as much significant as logistic knowledge and skills. This fact should be taken into consideration during planning, organizing and performing logistic support of a command post.

The new technologies improving military logistic support – a survey

This research has been carried out on representative group of War Studies University students from the following studies and courses: Postgraduate Operational-Tactical Studies, Higher Operational-Strategical Course, Higher Operational-Logistic Course, and some short-term courses. 101 questionnaires were verified and classified (33 by captains, 34 by majors, and 34 by lieutenant colonels).

Chart 1: The respondents' military rank characteristics

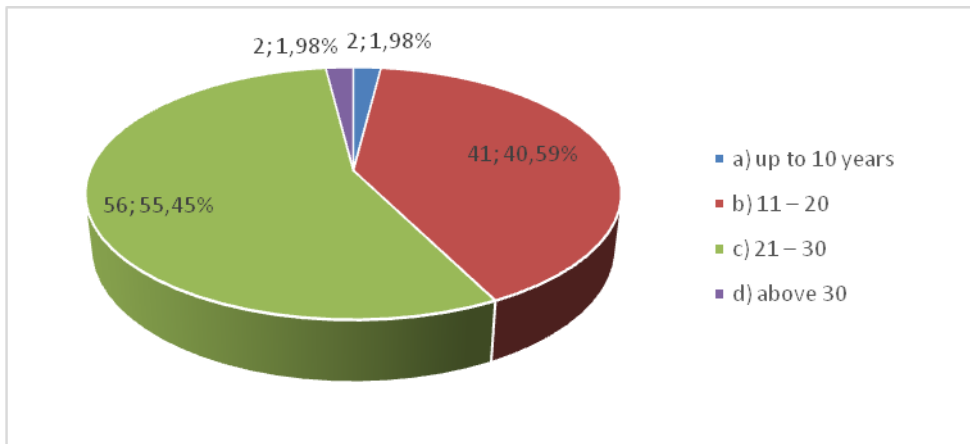
Source: the author's own research.

In order to collect the impartial opinions of the broad respondents' group the anonymous survey among junior and senior officers has been carried out. These officers originating from different military units and offices were studying at War Studies University at the time of survey. The author attempted to question officers who dealt with research subject during their hitherto service. They had different military specialties.

The research sample included 123 people. 101 questionnaires were verified and classified. 22 remaining questionnaires were not significant sources of information – the respondents did not have sufficient knowledge or did not answer the questions for other reasons. Some questionnaires were also not taken into account because they were partially filled or given answers were mutually exclusive.

The broad respondents' group consisted of both junior and senior officers with different ranks. These officers originated from different military units and offices. They also had different military specialties and different professional experience. This respondents' group structure was depicted in charts no. 1,2, and 3. The most numerous group was of these officers who served in the units subordinate to the Armed Forces General Command (almost a half of respondents' number – 49.5%). The second largest groups were ex aequo (17.82%) The Armed Forces General Command officers and the group officers from other military institutions and units. While the officers from the Armed Forces Operational Command made a group of 7.92% of all respondents. The smallest respondents' group was this of officers from the Inspectorate for Armed Forces Support (2.97%).

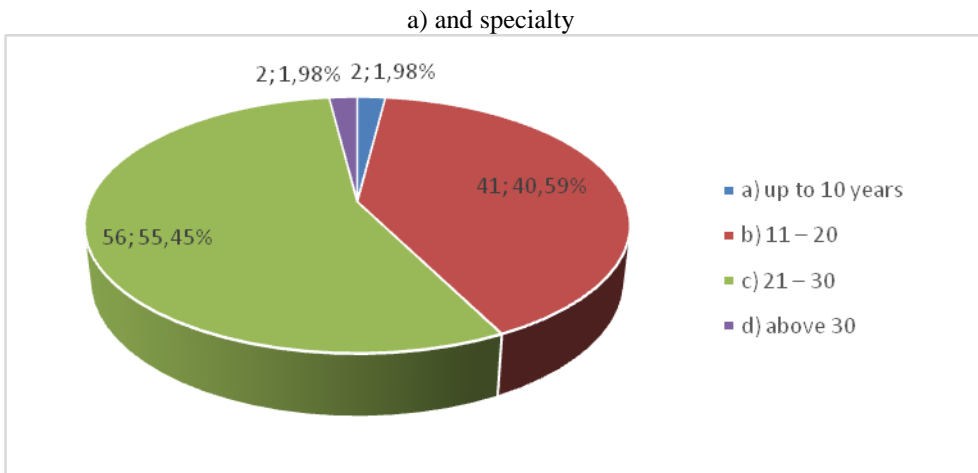
Chart 2: The respondents' job location characteristics



Source: the author's own research.

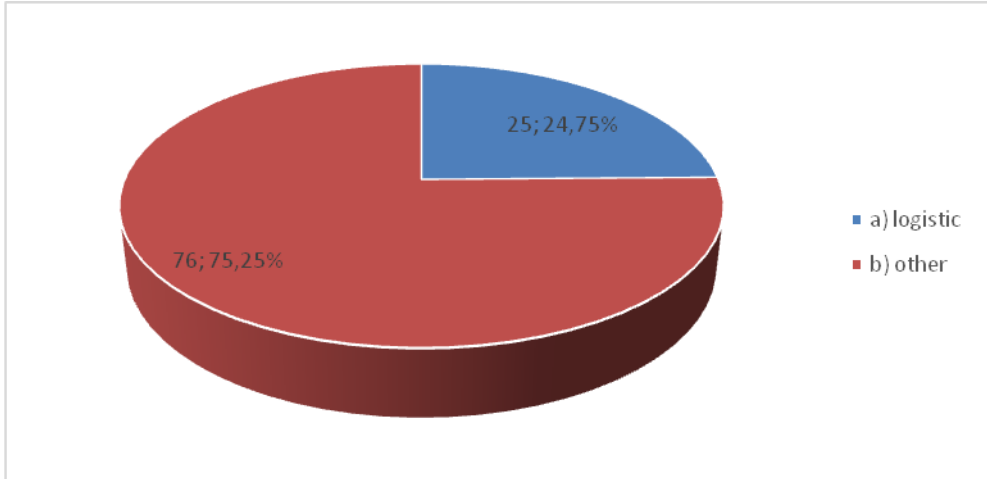
The majority served from 21 to 30 years (56 respondents). The second numerous group consisted of those who served from 11 to 20 years (41 officers). There were only 2 respondents with less than 10 years of experience. In the group there were two respondents with the longest professional experience (longer than 30 years). The data analyzed above shows that majority of respondents was experienced, with 21 years or more in the service.

Chart 3: The respondents' period of service (a) and specialty (b) characteristics



Source: the author's own research.

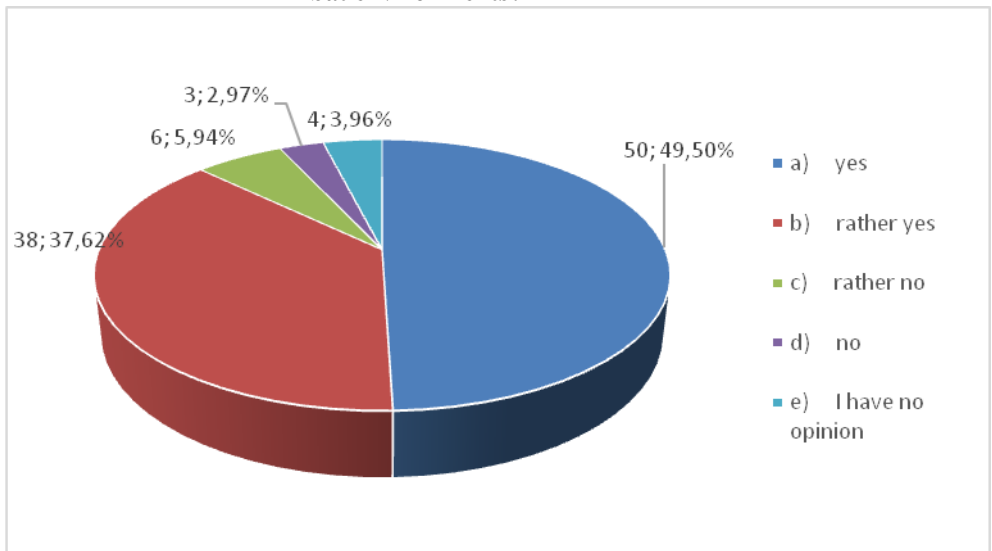
b) characteristics



Source: the author's own research.

The logistics officers were minority of respondents (25.75%). The majority was of other specialties (75.25%). They are current and future beneficiaries of the logistic support system.

Chart 4: Do you think that it is possible to use UAVs for the force protection of tactical level logistic units, logistic points and elements performing tasks in specific combat environments?

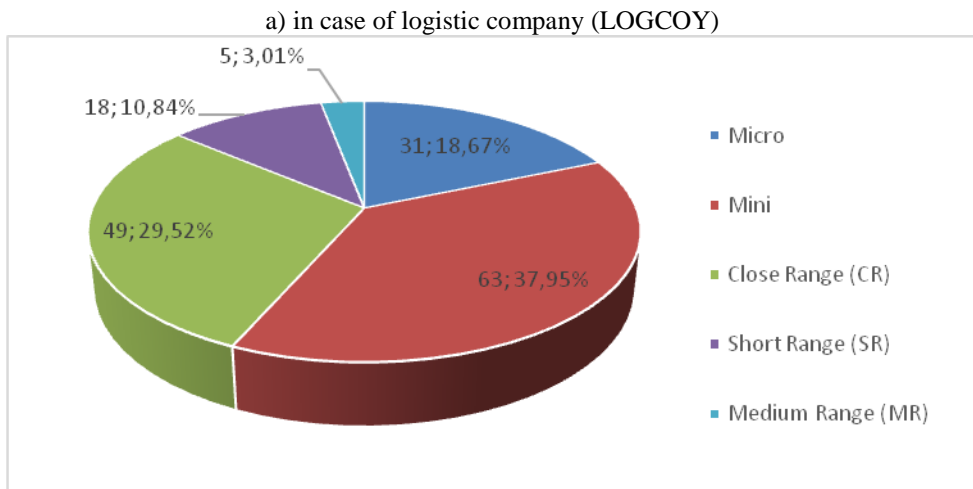


Source: the author's own research.

The results depicted in chart 4 show that more than 87,12 % of respondents regards such UAVs application possible. Only 8,90 % declared that it is rather not possible to use UAVs to protect and defend the logistic units, logistic points and elements. It means that great majority of respondents is open for the innovative technical solutions for supply chains security improvement and for the force protection of tactical level logistic units, logistic points and elements.

Chart 5 and 6 presents the respondents' opinion about UAV classes which might be used for the force protection of tactical level logistic units, logistic points and elements in specific combat environments. The answers were grouped according to: logistic company, logistic battalion, and divisional logistic support group.

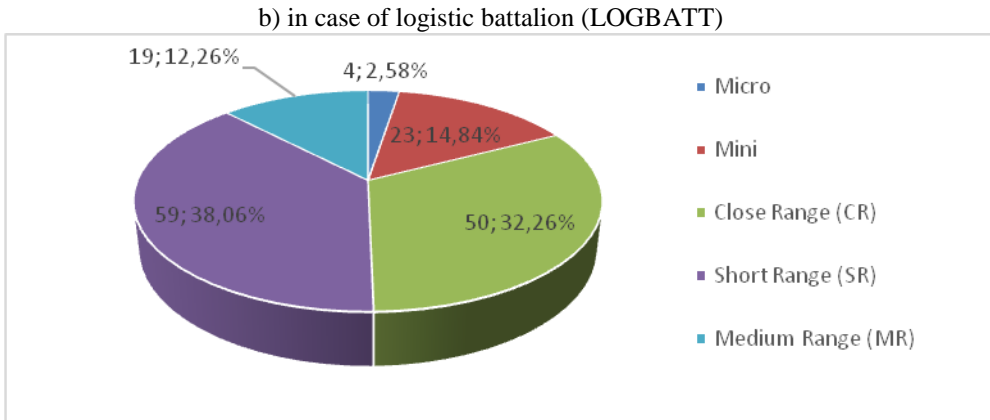
Chart 5: Which sort of UAVs should be applied for the force protection of tactical level logistic units and elements performing tasks in specific combat environments?



Source: the author's own research.

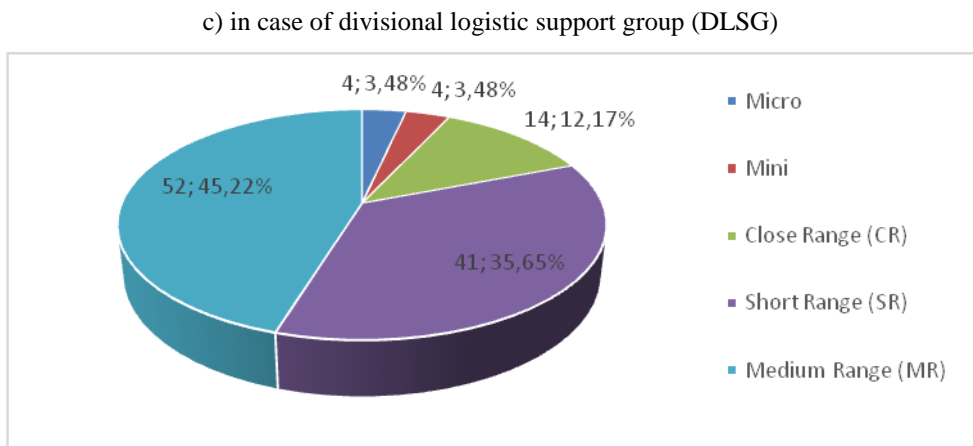
In case of using UAVs for protection of the elements and supply chains organised by logistic company (chart 5 a) 37.95% of respondents declared that miniature UAV (with operational ceiling lower than 300 m and maximum range up to 10 km and flight time 1 - 1.5 hours) are applicable. 29,52 % of respondents was for application of Close Range UAVs. In this case UAV is designed for the operations performed with operational ceiling lower than 3000 m and maximum range from 10 km to 30 km and flight time 3 - 6 hours. There was 18,67% of respondents who considered class MICRO applicable. This type of UAV is designed for company level where the range does not exceed 10 km and the ceiling is up to 250 m. 10,84 % of respondents consider class Short Range UAVs with operational ceiling up to 3000 m and range from 30 km to 70 km) and flight time 3 - 6 hours. Only 3,01 % of respondents answered that class Medium Range UAVs (ceiling up

to 5000 m, range from 70 km to 200 km and flight time 6 - 10 hours) are suitable in this case (*Klasyfikacje i wymagania dla bezzałogowych statków powietrznych UAV w Polsce*, Redakcja Militarium, <http://militarium.net/klasyfikacje-i-wymagania-dla-bezzałogowych-statkow-powietrznych-uav-w-polsce/>, (15.09.2017).



Source: the author's own research.

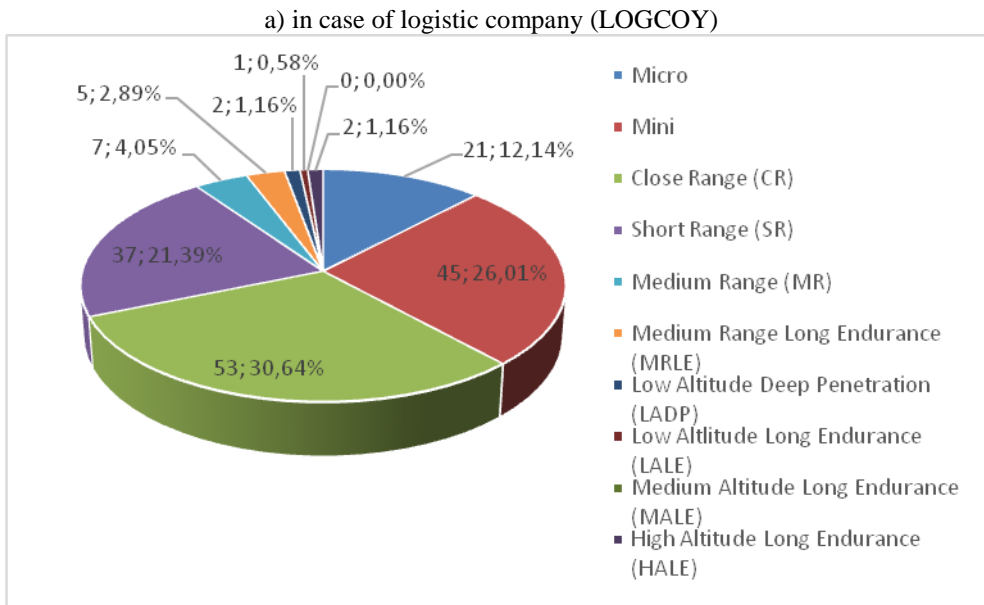
38.06% of respondents answered that class Short Range type UAVs should be applied for protection of the elements and supply chains organised by logistic battalion. There was 32.26% of respondents who considered class I Close Range type UAVs applicable in such case. 13.82% of respondents consider class Mini type UAVs applicable in such case. On the other hand, the use of the Medium Range UAVs was justified by 12.26% respondents. Only 2.58% of respondents have seen use of the Micro class.



Source: the author's own research.

Generally respondents regard only two UAVs classes applicable in case of DLSG. Class Medium Range type UAV (from 6 to 10 flight hours) is considered the most proper. The class Short Range type UAVs are considered the second most applicable. The parameters such as: ceiling up to 3000 m, range up from 30 to 70 km and flight time from 3 to 6 hours; make it useful in this case. In third place are unmanned class Close Range used at company / battalion. The fourth place was shared between class MINI type UAVs and class Micro type UAVs.

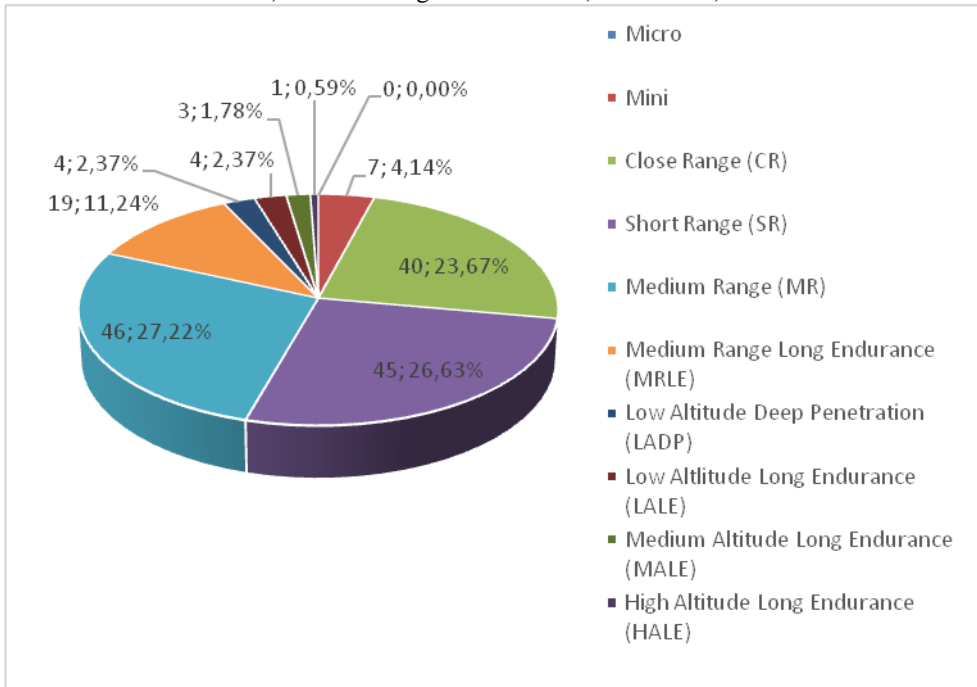
Chart 6: Which sort of UAVs should be applied for the force protection of tactical level logistic convoys which performing tasks in specific combat environments?



Source: the author’s own research.

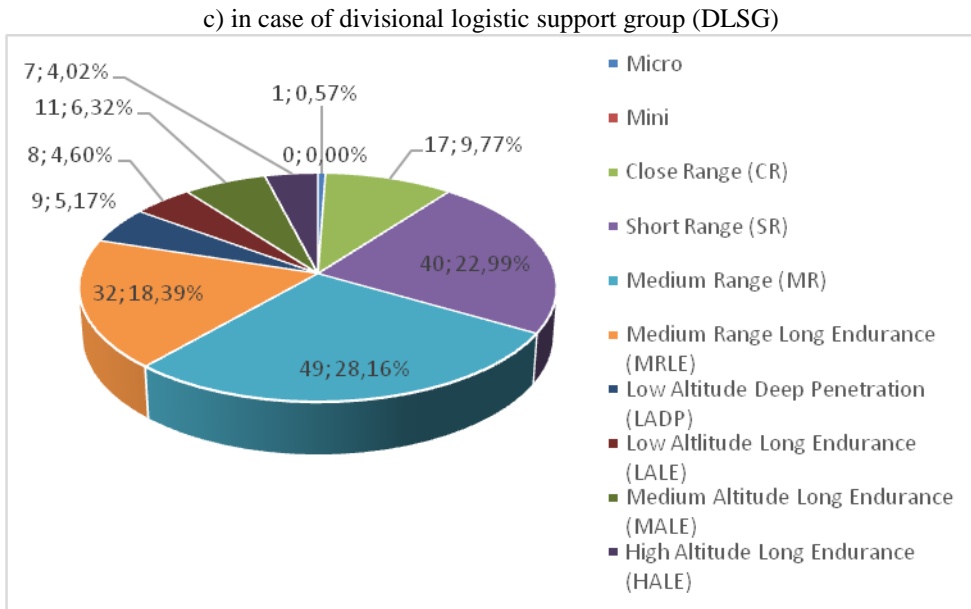
Chart 6 shows the answers considering the use of UAVs for the force protection of tactical level logistic convoys in specific battle environments. In case of supply chains performed by logistic company 30.64% of respondents declared application of class Close Range type UAV. It seems to be reasonable because of their ceiling up to 3000 m and operational range up from 10 to 30 km. 59.44% of respondents would use the Mini Clas (26.01%), Short Range (21.39%) and Micro (12.14%) respectively. Only just over 9.84% respondents consider the remaining classes type UAVs at this level should be used. This is due to the scope and purpose of these UAVs classes.

b) in case of logistic battalion (LOGBATT)



Source: the author's own research.

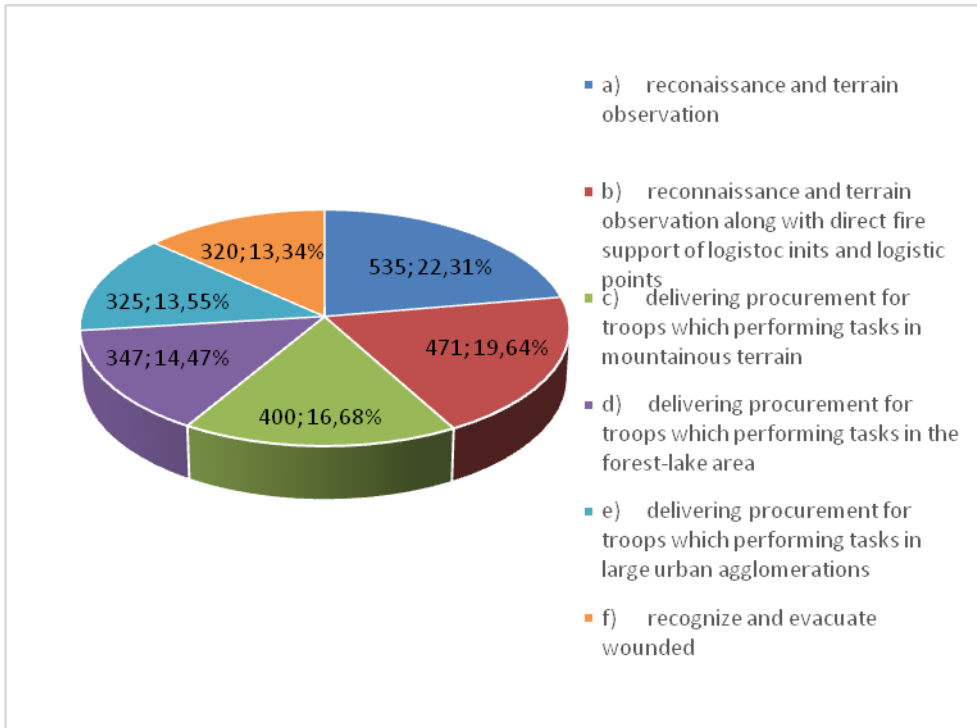
27.22 % of respondents answered that class Medium Range type UAVs should be applied for protection of the supply chains organised by logistic battalion. This class UAVs have a wide range (up to 200 km) and flight time up to 10 hours. These parameters provide operators with a great deal of freedom in the depths of the brigade group, where escorts or technical security arrangements are organized. Class Short Range type UAVs seem to be suitable in this case for 26.63%. Only 11.24% of respondents would use class Close Range type UAV on this level. Whereas other classes are consider optimal for this level by slightly more than 11 % of respondents. It is due to destination and the range of these UAV classes.



Source: the author’s own research.

Generally respondents regard only two UAV classes applicable in case of DLSG. Class Medium Range type UAV (28,16 %) is considered the most proper. The parameters such as: range up to 200 km and flight time from to10 hours; make it useful in this case. These parameters provide operators with a great deal of freedom in the depths of the brigade grouping, where escorts or technical security arrangements are organized. Class Short Range type UAVs seem to be suitable in this case for 22.99%. 13.82% of respondents consider class Medium Range Long Endurance type UAVs applicable in such case. Only 9.77% of respondents would use class Close Range type UAV on this level. It is due to destination and the range of these UAV classes.

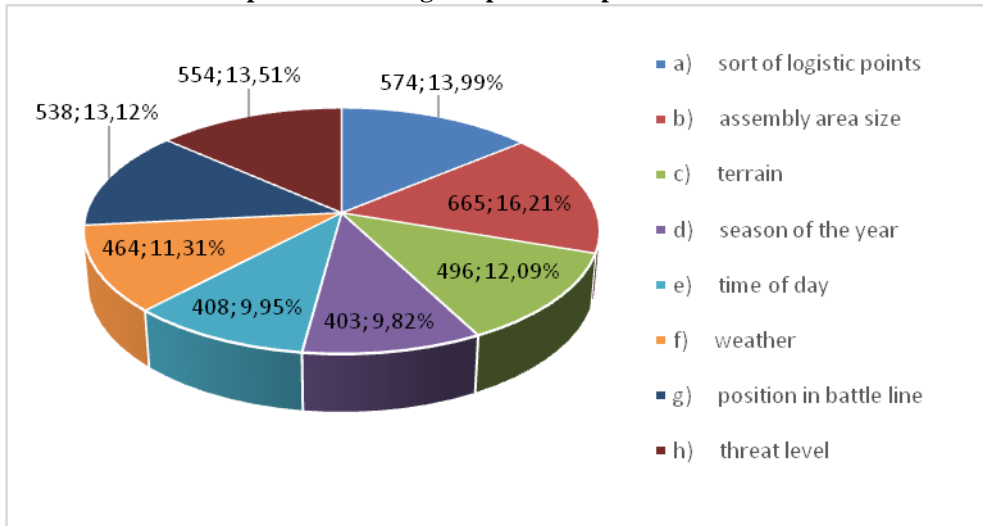
Chart 7: What kind of tasks might be UAVs used for in specific combat environments?



Source: the author's own research.

Chart 7. shows that the respondents' choices are distributed almost evenly. 22.31% of respondents deems that the UAVs might be used for: reconnaissance and terrain observation, in specific combat environments. The second chosen tasks sets (19.64%) were: reconnaissance and terrain observation and direct fire support for supply chain and logistics facilities on tactical level. It is due to the UAVs' capabilities of direct fire support on detected objects which threaten the logistic units, organised by them supply chains or established logistic points. In third place (16.68%) is delivering procurement for troops which performing tasks in mountainous terrain. The fourth place (14.47%) is delivering procurement for troops which performing tasks in the forest-lake area. The next place (13.55%) is delivering procurement for troops which performing tasks in large urban agglomerations. The most recent use (13.34%) concerns medical diagnosis and evacuation. Nevertheless, almost all of the respondents reported that all of tasks is very important in various combat environments.

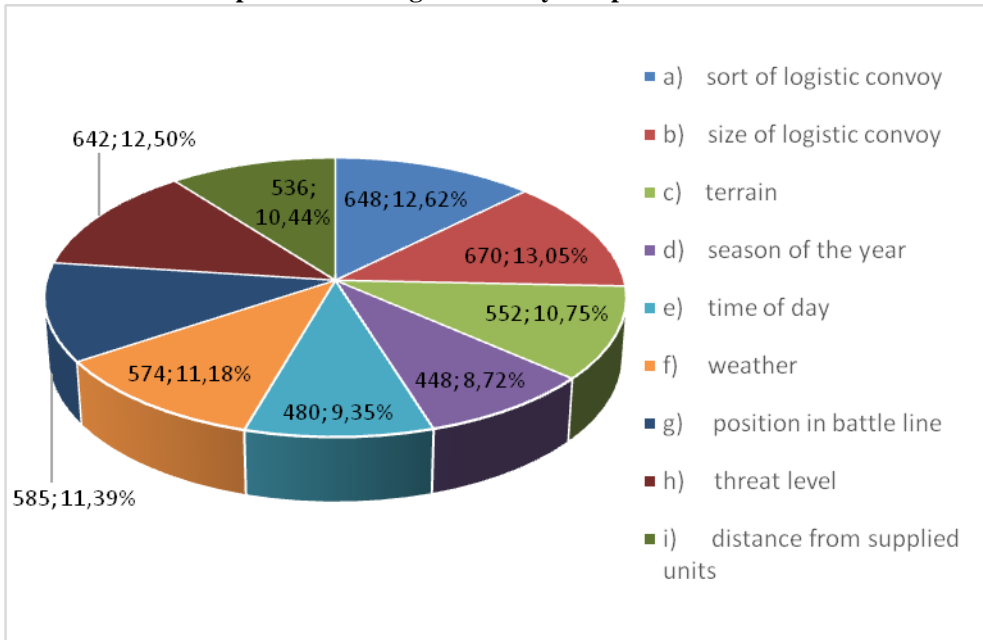
Chart 8: What should determine the sort, the number and the manner UAVs are used for the force protection of logistic points in specific combat environments?



Source: the author's own research.

There were eight factors distinguished in question from chart no. 9. These factors determined the proper selection of UAV sort, their number, and the manner of their use for the force protection of logistic points in specific battle environments. The respondents were to arrange them from first to eighth, where the first was the less important factor and the eighth the most important. The result of summing showed that for the respondents the most important factor was the size of assembly area (16.21%). The second most important were ex aequo (13.99%) – the sort of logistic points and the threat level, and, not much less important, logistic points' position in battle line (13.12%). The subsequent factors were (in order of importance): terrain (12.09%), weather (11.31%), and time of day (9.95%), season of the year (9.82%).

Chart 9: What should determine the sort, the number and the manner UAVs are used for the force protection of logistic convoys in specific combat environments?



Source: the author's own research.

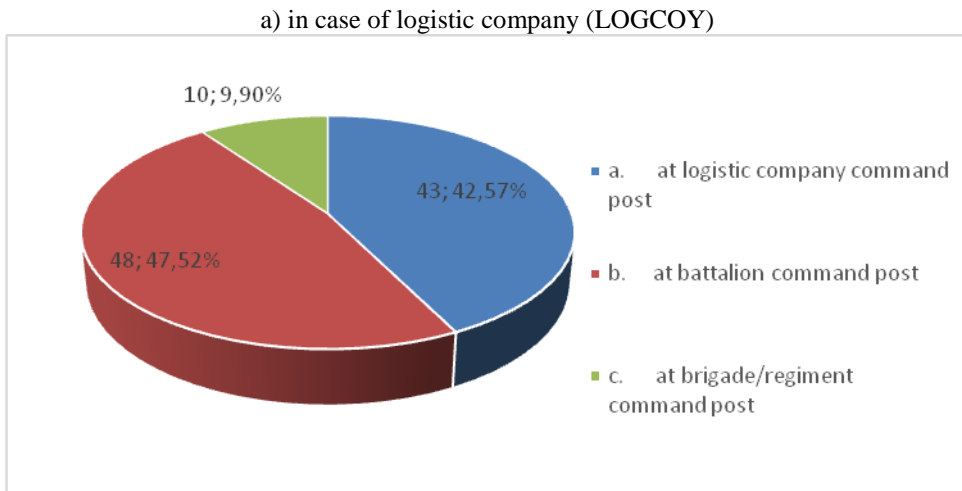
Chart 9. shows the respondents' opinion about the hierarchy of factors determining the UAV sort selection, their number, and the manner of using them for the force protection of logistic convoys performing tasks in specific combat environments. The methodology was similar to this from previous question. The respondents chose the size of convoy (13.05%) as the most important factor. The second was its sort (12.62%), the third – threat level (12.52%), and the fourth – the position in battle line (11.39%). The subsequent factors were (in order of importance): weather (11.18%), terrain (10.44%), distance from supplied units (10.44%), time of day (9.35%), season of the year (8.72%).

Charts no. 8. and no. 9. show that the most important determinants of choosing the sorts of UAVs, their number and using methods are: the size of assembly area/ size of logistic convoy; sort of logistic points/sort of logistic convoy; the location logistic points in battle line and threat level. These determinants seem to be logic and their influence on UAVs application rational.

The next problem being solved by respondents was the location of UAV control centre (chart 10). This problem was considered according to three command and control levels: logistic company, logistic battalion, and divisional logistic support group. In case of logistic company 47.52 % of respondents stated that battalion command post is the optimal location for UAV control centre. Logistic company command post for its location was chosen by 42.57% of them. Whereas only 9.90% regarded brigade/regiment command post as the best option for UAV con-

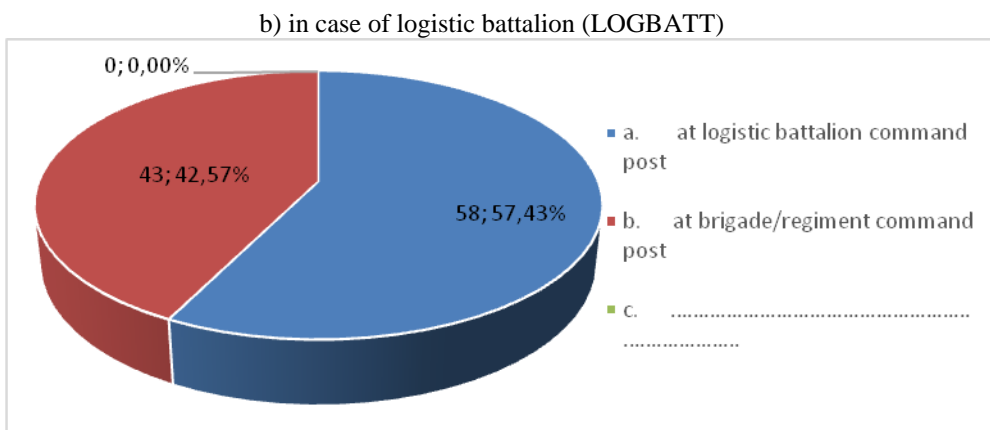
trol centre location. This research shows clearly that such centre should be located on the level of this unit which is responsible for planning and organize combat service support.

Chart 10: What is the optimal location for UAV control centre?

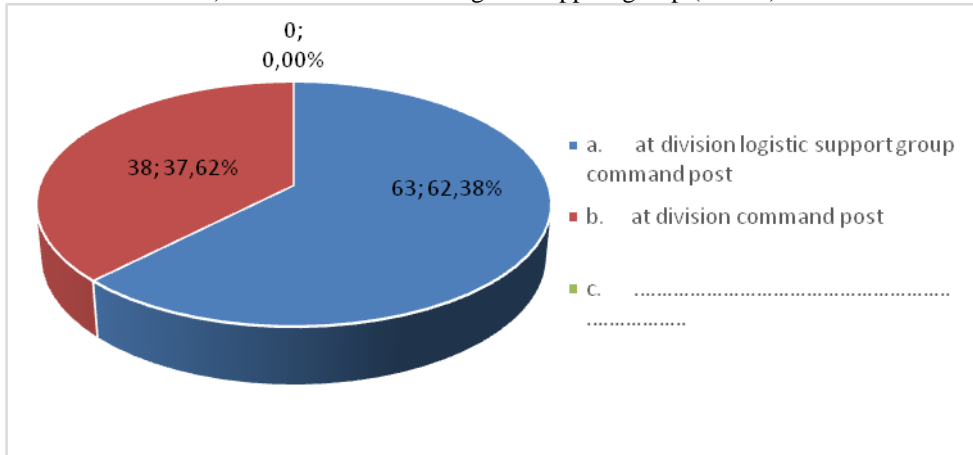


Source: the author’s own research.

In case of logistic battalion respondents chose logistic battalion command post as the best location for UAV operator (57.43%). 42.57% of them deems that such operator should work at brigade/regiment command post. Regarding divisional logistic support group 62.38% of respondents considers divisional logistic support group command post the best place for UAV control centre. While 37.62% states that such centre should be located at division command post.



c) in case of divisional logistic support group (DLSG)



Source: the author's own research.

The analysis of charts no. 10 b and c shows that the best location for UAV control centre on each command and control level is the command post of unit which profits from UAVs usage. It is due to the fact that the commander of adequate logistic unit will have the best knowledge about when, where, which sort of, and what number of UAVs should be used for the force protection of logistic units organising convoys, logistic elements, and logistic points. Only at the lowest level of command, the respondents' shows that the best location for UAV control centre should be the battalion / battalion command post.

Summary

The UAVs application for the force protection of logistic supply chains and logistic points established on each command and control levels in specific combat environments is one of the methods of ensuring their security. This solution meets the requirements of tactical level logistics which does not have adequate force protection means. The problem is to properly identify the factors determining the choice of UAV's suitable class. From the analysis of UAV applications and inquiry results the conclusion might be drawn that it is reasonable to use the unmanned aerial vehicles on tactical level for the force protection of logistic points and for formation of secure supply chains. The research results show that UAVs should be used for reconnaissance and terrain observation along with direct fire support for logistic units organising supply chains and logistic points in specific combat environmental. One of analysis results is the conclusion that the most important determinants of UAV sort selection, their number and the way they are used are: the size of assembly area/ size of logistic convoy; sort of logistic

points/sort of logistic convoy; the location logistic points in battle line and threat level. According to command and control level the aerial platforms of intelligence subsystem and armed forces protection subsystem should be used, so they can play the guard role. The research showed that small or medium-sized systems operating at low altitudes fulfil these requirements. While the long supply routes imposes the necessity of using this sort of UAVs which can fly for a long time. Additionally the delivery, loading, unloading and returning time should be taken into account. Regarding the UAV control centre, the best its location is the command post of this unit which benefits from using unmanned aerial vehicles.

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