
Strategic Cargo Management by Air Transport: Safety Aspects

Submitted 17/11/20, 1st revision 19/12/20, 2nd revision 12/01/21, accepted 16/02/21

Tomasz Jałowiec¹, Paulina Mastlerz², Tomasz Smal³, Henryk Wojtaszek⁴

Abstract:

Purpose: The aim of the research is to indicate the essence of strategic air transport management in the direction of security.

Approach/Methodology/Design: The analysis of the literature review, the "case study" method, expert interviews and statistical analysis of the obtained data were used in order to formulate generalized conclusions that will be used to build reliability and safety models, and then to develop the concept of an IT support system.

Findings: The problem of managing the transport of strategic goods is poorly recognized. The outsourcing of transport services to military entities takes place regularly and is an effective strategy to support PAF in the field of specialists and means of transport. Studies have found that PAF has a large number of errors. Companies that provide transportation services to military entities should be also prepared for securing side quests. As a result of the research, the strategy implementation procedures transport of goods, including procedures for commissioning transport from a civil carrier were founded. The frequency of adverse events that affect safety. The implementation of transport processes were also identified.

Practical Implications: The conducted research will allow in the next stage to develop a detailed model management of the transport of strategic goods in the context of its safety. They will also make it possible to estimate the level of risk in particular phases model and allow us to develop organizational solutions that eliminate or limit frequency of adverse events.

Originality/Value: The variety of research methods used and a comprehensive overview of interature allows us to clearly confirm the originality of the study.

Keywords: Strategic, cargo, management, air transport, safety aspects.

JEL codes: L62, L91, L93, H12, J5, R41.

Paper type: Research article.

¹Professor, War Studies University, Logistics Institute, Management and Command Faculty, Poland; e-mail: t.jalowiec@akademia.mil.pl;

²Picadilla Games, Wroclaw, Poland; e-mail: krawczyszynp@gmail.com;

³Professor, WSB University in Wroclaw, Management and Finance Faculty, Poland; e-mail: tomasz.smal@wsb.universities.pl;

⁴ h.wojtaszek@akademia.mil.pl;

1. Introduction

Military operations are an important element of the security of the state. In the current world, sending troops to various regions threatened with destabilization is an element of ensuring peace, and at the same time fulfilling the obligations of allied treaties and international agreements. Aircraft are very often chosen for the transport of strategic goods. This type of transport is of particular importance when sending goods to landlocked countries – e.g., Chad, Afghanistan. In addition, the great advantage of air transport is the time of the entire process, which is much shorter than in the case of sea transport. However, some armies do not have a sufficient air fleet to support own military operations, so strategic transports are organized through civilian companies. In case of strategic goods, the institution dealing with the organization must follow certain procedures imposed by the Ministry of Finance and Ministry of National Defence.

The trade in strategic goods is strictly controlled in order to avoid trade and avoid illegal use, although an effective transit control system has only recently gained importance. This happened at the beginning of 2012, when, despite the arms embargo imposed by the European Union on Syria, a Russian ship loaded with military equipment sailed to Syria through the international waters of several European countries to supply weapons to the local regime (Shpak *et al.*, 2018).

From the practical point of view, air transport management of strategic goods is a complex process, influenced by many factors. Some of them are unstable factors. This means that their impact on airborne operations is changing dynamically. Air cargo transport is inextricably linked with the existing infrastructure (airports, means of transport, network of air connections) and the availability of services related to the movement of cargo (including warehousing services) (Senguttuvan, 2016). It is subject to limitations resulting from efforts to minimize its negative impact on the natural environment, such as e.g., measures taken to reduce noise in the vicinity of airports (especially at night), or to control exhaust emissions⁵. Appropriate managing of an air operation is related to the selection of the appropriate (technically) type of aircraft (e.g., with a specific payload and range available to individual models). Flight schedules / route selection, operating costs and the purchase or lease price of the aircraft also play an important role in the managing process.

2. The Essence of the Studied Issues

Air transport takes place in the presence of numerous legal requirements imposed by existing regulations. Some of them are constituted at the global and regional level and others are at the level of national and local government. The organization of air transport involves the acquisition of appropriate permits for flight and landing. The transport of arms and dual-use goods may be subject to trade or diplomatic procedures.

⁵ There is an emissions trading system - "emission trading scheme".

It can be implemented through military transport or transport organized by civil contractors. It should be taken into account that in the transport process, there may be non-standard situations, such as airplane engine failures. In order to ensure safety when they occur, the planning takes into account the ETOPS certification levels of the aircraft. In order to unload queues on the ground, in conditions of too high traffic congestion, the plane may be delayed and its route may be changed (Belobaba, 2015). Also, the impact of unexpected weather conditions may require dynamic route changes (i.e., re-routing) (Koksalmis, 2019). Moreover, unfavourable weather affects the operation of airports. In the management process, it is necessary to track dynamic changes. Maintaining situational awareness is the starting point for taking appropriate action (e.g., informing the customer about a possible delay in delivery).

The last, but no less important of the determinants mentioned here, influencing the possibilities of transport implementation, is the complex legal and geopolitical environment, especially since it is an international environment (and thus very diverse), and the transported cargo is extremely sensitive (strategic goods can be a major threat to international peace and security). An expression of the efforts made by the international community to prevent their destabilizing accumulation in high-risk regions is the existence of many control mechanisms and sanction systems, which have a particular impact on the issue discussed here (Ministry of Foreign Affairs Republic of Poland, 2020). Some of the strategic goods are classified as dangerous goods. In this case, follow the provisions of the DGR (Dangerous Goods Regulations of IATA). They apply to transport, packaging and all activities related to this type of cargo.

The concept of security is complex and defined in many ways. For a long time, security was understood as a state that guaranteed the certainty of existence and survival (Majer, 2012). Today, such an understanding is insufficient and too narrow. Currently, safety can be classified according to various factors. In general, it can be assumed that security is the freedom from unacceptable risk (Bris and Soares, 2009). In the context of air transport, it must be said that without strict safety rules, air transport would not be able to develop because there would be no willing to travel. In addition, the aircraft enables long distances to be covered in a short time and therefore international cooperation in the field of aviation safety is essential. Moreover, it should be mentioned that statistically, air transport is the safest type of transport. Annually, around 1.3 million people die in road accidents in the world⁶, while in the years 1918 - 2016, according to the statistics kept by the Bureau of Aircraft Accidents Archives, less than 150,000 people died in air accidents. Safety in transport is also identified with controlling functioning safety systems to make sure that they are working as they should and provide protection against undesirable events. In Poland, air traffic safety is supervised by a number of organizations and institutions⁷:

⁶<https://asirt.org/initiatives/informing-road-users/road-safety-facts/road-crash-statistics>

⁷<http://mib.gov.pl/2-Bezpieczenstwowruchulotniczym.htm#>

- Ministry of Infrastructure and Construction - the supreme government administration body competent in civil aviation matters;
- State Commission on Aircraft Accident Investigation - investigation of air accidents and incidents in the country, acts on behalf of the minister responsible for transport;
- Civil Aviation Authority - collecting, assessing, processing and storing information on aviation incidents;
- Civil Aviation Protection and Facilitation Council - advisory body to the Minister of Infrastructure;
- other international institutions that have an impact on the organization of civil aviation in Poland due to the applicable international agreements.

For the purposes of this study, it was assumed that safety is the probability of the occurrence of threats that have a detrimental effect on the proper functioning of the logistics system, which is air transport⁸. On the other hand, safety in air transport is a feature of the system that enables operation in given environmental conditions, without accidents and undesirable events⁹.

With regard to strategic transport, the safety system of this process is multi-level and consists of: the current political situation, legal regulations, procedures defined by individual countries and carriers, technical and organizational security during the transport process, experience and training of personnel organizing and implementing transport (Jałowiec, 2017).

Reliability is determined differently in many areas. In the literature, one can often find references to critical infrastructure (Pursiainen, 2018) or risk analysis (Johnsen, 2010). On the basis of the analysis and forecast of the logistic activity of various types of enterprises, it can be noticed that, regardless of the scope of the enterprise's activity, reliability was considered the most important feature of the logistics process (Straube and Cetinkaya, 2008).

According to Bruneau and Chang (2003), reliability is the physical, social, organizational and economic ability to be reliable and the ability to deal with undesirable situations. The concept of reliability is related to several properties. First of all, it is resistance, redundancy, efficiency and speed. According to Seifert and Bochukova¹⁰, the reliability of the supply chain can be defined by its transparency, flexibility, ability to cooperate and system control. According to Milan Janic (2019), the reliability of a given technical system means its ability to operate in variable and unexpected conditions without significantly compromising the assumed tasks.

⁸Nowakowski T., *Niezawodność systemów logistycznych*, str. 26.

⁹Żurek J., *Wybrane metody oceny bezpieczeństwa w lotnictwie*, [w:] *Problemy eksploatacji*, 4-2009, str. 61–70.

¹⁰Seifert, R. &Bochukova, P. 2014. *How resilient is your supply chain? Financing the chain*. *ECR Journal*, April 2014, pp. 33–38.

In many cases, reliability is considered as the ability to neutralize the effects of various types of internal and external adverse events. Additionally, reliability reflects the strength of a given system to withstand unforeseen conditions (Foster and Foster, 1993). When considering the reliability of transport networks, delays and cancellations of individual services due to the impact of various disruptions are commonly considered. The scale and extent of the deterioration of planned services or their survival under the influence of given impacts reflect the reliability and vulnerability of their counterparts. In this sense, the deterioration of the reliability of a given transport network by removing (closing) individual nodes (terminals) and connections (services) is represented by the so-called the fragility of the network in question (Ip and Wang, 2011). The disruptions that may affect the transport networks are mainly:

- bad weather conditions, such as dense fog, heavy rains or blizzards, very strong winds, hurricanes, etc.;
- usually unforeseeable, catastrophic failures and damage to elements of transport networks;
- protests of personnel related to the operation of transport networks;
- natural disasters, e.g., earthquakes, volcanic eruptions, sea tides;
- accidents during the transport process;
- terrorist threats and attacks.

Based on the analysis of the above definitions, it can be assumed that so far reliability has been understood and defined in various ways. Nowadays, reliability is understood a bit more broadly as the ability of the system to restore full efficiency after an undesirable event occurs and a set of properties that describe the readiness of the object and affect it, damageability, maintainability and the provision of service means¹¹.

The last term important for further analysis are strategic goods. The term have been carefully described and defined. In Polish law, the transport of strategic goods is carried out in accordance with Council Regulation (EC) No 428/2009 of May 5, 2009 establishing a Community system for controlling exports, transfer, brokering and transit of dual-use items and the Act on foreign trade in goods, technologies and services of strategic importance for state security, as well as for the maintenance of international peace and security. According to the Act, armaments, military equipment and dual-use items are considered strategic goods¹². While the first element of the definition is clear, the second one may pose some problems. These are products, including software and technology, that can be used for both civil and military purposes, and include all goods that can be used both in non-explosive applications and in any way to assist in the manufacture of nuclear weapons or other nuclear explosive devices.

¹¹Nowakowski T., *Niezawodność systemów logistycznych*, str. 89

¹²Rozporządzenie Rady (WE) nr 428/2009 z dnia 5 maja 2009 r.

The given definition is relatively broad, therefore, to facilitate the work with strategic goods, 10 categories (Table 1) have been created to which the given goods are assigned. All these products have been included in the "Dual-Use Commodity and Technology Checklist" which is annexed to Council Regulation (EC) No 428/2009 of 5 May 2009, establishing a Community system for the control of exports, transfer, brokering and transit for dual-use items. Information on strategic goods can be found on the website of the Ministry of Finance¹³ or the Ministry of Foreign Affairs¹⁴, where the conditions for restricting the transport and export of goods, as well as the criteria for assessing export applications for arms and dual-use goods.

Table 1. Categories of strategic goods

| Category | Name of category | Examples of strategic goods |
|----------|---|---|
| 0 | Nuclear materials, installations and devices | Nuclear reactors, devices and components, designed to separate isotopes. |
| 1 | Special materials and related devices | Bulletproof vests, gas masks, selected fluids and lubricants, human pathogens. |
| 2 | Processing of materials | Bearings, selected types of machine tools, lathes and grinders. |
| 3 | Electronics | Integrated circuits, acoustic wave apparatus, some analog and digital image recorders. |
| 4 | Computers | Electronic computers and related equipment such as processors, equipment designed to amplify images or signals. |
| 5 | Telecommunications and "information security" | Laser equipment components, remote control technology, technologies for the development of cellular digital radio systems |
| 6 | Sensors and lasers | Probes working vertically, acoustic reflectors, optical detectors, some recording cameras, various types of lasers. |
| 7 | Navigation and avionics | Radars, some gyroscopes and angular velocity sensors, navigation systems, some GPS devices, altimeters. |
| 8 | Ship equipment | Unmanned underwater vehicles, ship propulsion systems. |
| 9 | Cosmonautics, aeronautics, propulsion | Aircraft turbine engines, rocket propulsion systems, hydrogen storage and transport equipment, unmanned aerial vehicles, liquid fuel tanks. |

Source: Own study based on the Regulation.

In the literature, dual-use goods are most often described in different contexts. Individual authors often emphasize the importance of controlling trade in weapons

¹³http://www.finance.mf.gov.pl/pl/clo/ograniczenia-obrotu/-/asset_publisher/gA0k/content/towary-o-znaczeniu-strategicznym.

¹⁴https://www.msz.gov.pl/pl/polityka_zagraniczna/polityka_bezpieczenstwa/kontrola_eksportu/kryteria/kryteria.

and dual-use goods, and point to gaps in the system that lead to violations of international agreements.

3. Legal Conditions in the Field of Strategic Goods Transport by Air Transport

The idea of unifying international regulations in the field of arms trade is aimed at preventing the proliferation of weapons and other strategic goods in countries or among institutions that are commonly considered terrorist or criminal. It is also important among countries that transport strategic goods for military purposes. Control of trade in strategic goods is of particular importance for the foreign policy of the United Nations and the European Union.

In Poland, this issue is regulated by the "Act on foreign trade in goods, technologies and services of strategic importance for state security, as well as for the maintenance of international peace and security" (Journal of Laws of 2013, item 194). The document is a consequence of the modification of the domestic law as part of Poland's preparations for joining the European Union. The Act contains provisions from before 2000. The regulations contained in earlier documents are used in the form of procedures for issuing individual permits, their withdrawal or amendments. These can be, for example, international import certificates, delivery certificates or end-user certification (end user statement). Additionally, there are general and global permits for export, import, transit of controlled goods and technologies. The control over goods that are not listed on the checklists has also been extended, but there is uncertainty regarding their possible application, therefore additional technology control has been introduced.

The above Act is a kind of legal basis in Poland and regulates specific provisions in the field of transporting weapons, armaments and dual-use goods within the country. However, in order for the control over compliance with the act on the trade in strategic goods to be efficient and effective, the Internal Control System (WSK) was introduced for foreign trade in strategic goods. It is a kind of extension of the quality management system included in the ISO 9001: 2000 standard. WSK has been operating in Polish law since January 1, 2003. The main problem of entities dealing in trade in weapons or dual-use goods is obtaining a WSK certificate for their company.

According to the ISO 9001: 2000 standard, WSK is one of the elements of the system ensuring international security¹⁵. It is one of the most important tools to prevent the uncontrolled proliferation of weapons, technologies or services of strategic importance for the security of the country. WSK is introduced, regardless of the size and type of organization, primarily in:

- industrial enterprises;

¹⁵<http://www.iso.org/pl/pn-n-19001>

- trading companies;
- research and development organizations;
- intermediary organizations (e.g., carriers, transshipment companies, etc.).

The principles of operation of the Internal Control System are regulated by the European standard PN-N 19001. Thanks to this, it is possible to verify the activities of an organization that participates in the turnover of strategic goods, thereby increasing the level of international security. An application for placing strategic goods under customs procedures may only be addressed to selected customs offices. The condition for trading in strategic goods is to have or use an appropriate permit¹⁶. National and EU regulations provide for three possible permits¹⁷:

- individual and global permit issued at the request of the interested entrepreneur by the national trade control authority - the minister responsible for economy,
- permanent permit.

Additional regulations, which are taken into consideration, are guidance and procedures for preparing hazardous materials for shipment by military aircraft to ensure that such materials are packaged, marked, labeled, and prepared properly for transportation. They are included in US AFMAN 24-204 IP Preparing Hazardous Materials For Military Air Shipments¹⁸. This regulations are used among others by the Company of Airport Service in Wrocław.

It should also be noted that the entire strategic goods transport system is very sensitive. Therefore, in order to eliminate the obvious risk related to e.g. taking control over strategic goods, integrated refusal lists (ZLO) have been created by states and organizations. They include institutions, states and groups with which trade in foreign goods is prohibited. Most often it is related to the political situation of a given country or actions of a given organization, which are condemned by other countries. Poland does not have its own ZLO, so we use lists created by the United States or the European Union. Such lists are updated on a regular basis, depending on the current political and military situation.

4. Subject and Purpose of Research

There is limited interest among scientists in the area of transport of strategic goods. Comprehensive research in this area is hard to find in the available literature. This may be due to limited access to a sufficient amount of data, which is usually

¹⁶http://www.finanse.mf.gov.pl/pl/clo/ograniczenia-obrotu/-/asset_publisher/gA0k/content/towary-o-znaczeniu-strategicznym.

¹⁷Review with the Expert - Dariusz Janasz, Director for military purposes from Kuhne + Nagel Company.

¹⁸Air Force Interservice Manual 24-204. Preparing hazardous materials for military air Shipments. 11 December 2001.

confidential, and the fact that this type of transport is a marginal area of operation for transport companies. Another reason is the very low repeatability of this type of processes, which are carried out irregularly and on a specific order, usually by the armed forces.

Therefore, it is so important to analyze the entire process of managing the turnover of strategic goods and consider what measures will allow for the best possible control of its security. Each chain is only as strong as its weakest link, and the fact that the chain of international trade in strategic goods is tied to different jurisdictions creates certain risks. As a consequence of the current legal conditions, the authorities of a given country lose control over strategic goods that will leave its territory. Thus, they have to rely on information from other countries to verify that cargo requirements are also met beyond its borders. In this situation, it is obvious that proper management of the strategic goods transport process is an important element in achieving not only its high efficiency, but also reliability in the context of safety. As a result of the literature research, it has been found that there are currently not many tools, such as decision models or IT systems, that would methodically support people managing the transport of strategic goods. This fact is of particular importance for people who have no previous experience in military transport and can have serious implications for the safety and reliability of the entire process.

Considering the above, it was decided to conduct research that will allow to develop a model of the process of strategic goods transport by air transport, identify sensitive elements in this process and determine the probability and risk of their occurrence. As a result, the results of the conducted research will be used to develop the concept of an IT system supporting the management of these processes. For this purpose, the following were used:

- extensive analysis of the literature on the subject, which made it possible to learn more about the current state of research in the area of strategic transport;
- the "case study" method, which was used for a detailed analysis of specific cases of strategic transport for the needs of the armed forces;
- expert interviews with people who implement the studied processes in practice in order to obtain answers from them to detailed questions about the organization of the examined processes, and in the next stage of the research, to establish statistical data in the context of the sensitivity of individual phases of these processes;
- statistical analysis of the obtained data in order to formulate generalized conclusions that will be used to build reliability and safety models, and then to develop the concept of an IT support system.

5. Procedures of Transport of Strategic Goods

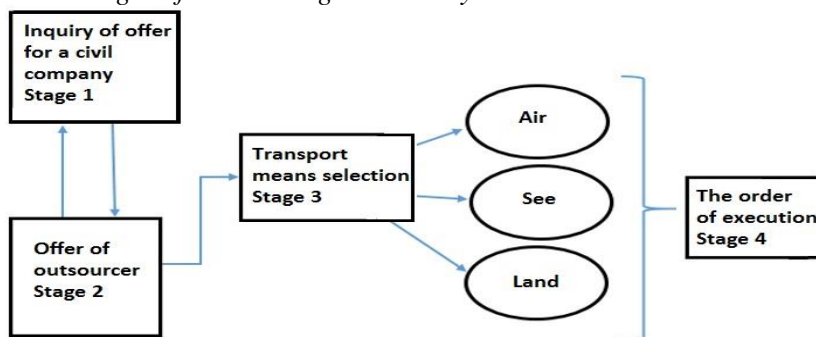
Transport of strategic goods is possible with the use of various branches of the army. However, in the case of large-scale transport tasks and remote theatres, there are too

few of their own means of transport, hence the Polish Armed Forces (the PAF) use various international initiatives and solutions that allow to increase the capacity to relocate troops (Milewski and Smal, 2018). For example, as part of the Greek program, the PAF can acquire, through the Sea Transport Coordination Centre in Athens, the Greek potential of maritime transport in a maximum of 30 days. Similarly, in the case of air transport, as part of participation in the SALIS and SAC programs, the Polish Armed Forces may obtain additional air transport measures of strategic scope, such as Galaxy 17 or AN – 124 (Biernikowicz *et al.*, 2010).

Another option is the outsourcing concept which is used on a large scale in the PAF (Smyk, 2007). This concept generates a number of benefits - especially economic ones, but also generates certain risks, leading to a decrease in reliability and reduced security of the processes in question. In practice, the outsourcing process for military entities is very complex and difficult to implement in legal and organizational terms. A company that wants to establish cooperation in the field of transport services for the army must be familiar with the specification of transported cargo, documents needed to complete the service and the certificates required by the client. Depending on the specification of the transported cargo and from the client, the requirements differ to a large extent (Smal and Gajowiak, 2019).

Preparing a company to outsource transport services to military entities requires appropriate competences from people who organize such a process, including knowledge of military equipment, cargo codes and cargo specification. The outsourcing process for the army consists of several phases. The individual phases are presented in Figure 1.

Figure 1. The stages of outsourcing in the army



Source: Smal T., Gajowiak N., *Safety and Reliability*.

Phase I is a message of an offer for companies that can perform a transport service. The offer includes basic information about the client, the conditions for the submission of offers and the specification of the cargo, which the client wants to deliver, the place of taking the cargo and the place of unloading.

During the phase II, companies interested in the implementation of the transport service prepare a cost estimate of the order. They include in their transport offer the total costs of the entire undertaking, starting from administrative costs, outsourcing services and transport costs. Such documents are intended to verify whether a given company meets military requirements according to legal regulations, which are included in the request for proposal. Such documents may be letters confirming the solvency of the contractor (National Register of Debts), the criminal record of all persons participating in the execution of the order, (National Court Register) and a document from the Tax Office. It also depends on the organization that outsources the service. Each army has different requirements, for example, the Polish Army requires from the contractor all of the above documents already in the second phase, although the civil company has no guarantee that he will win the tender. These are additional costs for the company that covers it "own. In the second phase, the company is announced that meets the best conditions for the army. Most often, it is a company that will present the cheapest offer. After the aforementioned activities, an outsourcing contract is concluded, after which the company performs the service.

Phase III is the choice of means of transport. The company that chose the tender selects the means of transport appropriate to the specification of the transported cargo. When it comes to military loads, they must have special preparation for transport, for example, there must be a secured cargo, properly stored and, of course, insured. A civil company must meet all the requirements that have been included in the offer. If the transport concerns weapons or ammunition, such transport must be properly secured during transport and storage, for example by special protection, which works on behalf of a service company.

Phase IV concerns the performance of the service and writing the protocol closing the order. In this phase, detailed reports of the entire transaction are transferred and the service fee is realized.

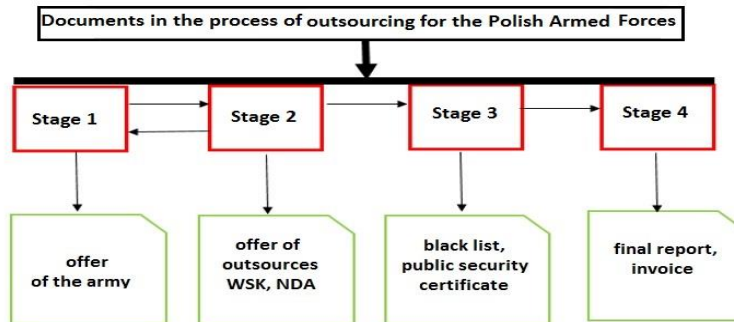
In each of the above-mentioned phases of information flows, each change should be forwarded and agreed. In the flow of information, the e-mails are most often used, but sometimes the flow of postal information occurs, which is associated with a long waiting time for information and documents. In each phase of outsourcing, other documents are required to carry out the transport service. Particular requirements in each phase are presented in the Figure 2 (Smal and Gajowiak, 2019).

The most important document in the process of outsourcing for military entities is an offer inquiry for civil companies, because it contains basic information about a given order. It usually consists of 4 points (in the case of orders from the PAF), which the company must meet, namely (Ibidem):

- information about the ordering party;
- ordered object;
- legal, financial, economic and technical information;

- procedure - the criteria for the evaluation of individual offers and the manner of making offers available are specified.

Figure 2. Documents in the stages of outsourcing process.



Source: Smal, T., Gajowiak, N., *Safety and Reliability in the Management*.

The next important document for military transport is WSK (internal control system) prepared individually by civilian companies. If the company creates a "manual", WSK gets a certificate, which is often required when submitting an offer to carry out a service. For example, the Company Kuehne + Nagel has its own internal manual in which it is presented to all employees working for the company. The president of the company declares in the document what will be implemented in the coming months or years in the company, the scope of responsibility of individual work positions and the division of tasks. There are also defined stages of personnel selection for particular positions, training, courses, and the process of controlling the company. Functional persons, board members and their responsibilities are also defined. The WSK document also contains information on the refusal list. This is a list on which all companies and financial loads are displayed. Most often, such a list includes companies that have not fulfilled their previous contracts or are entered in the international register of companies on the black list.

Poland does not have a black list. Polish companies use lists created by the European Union, Great Britain or America. The black list is constantly updated. There is information about a company that cannot perform transport services for various reasons, eg. failure to contract, bankruptcy, insolvency or suspension of activity. Each company that provides transport services to military entities should have access to the register if contracts for subcontractors are concluded for a given service. The list of refusals may also include goods that the company is prohibited to carry. This may be due to the non-receipt of transport permits for the given cargo or the lack of a suitable means of transport for this type of order. An important element of the list of refusals is also countries to which cargo cannot be transported, eg. due to the assumed embargo (prohibition of export or transport of goods).

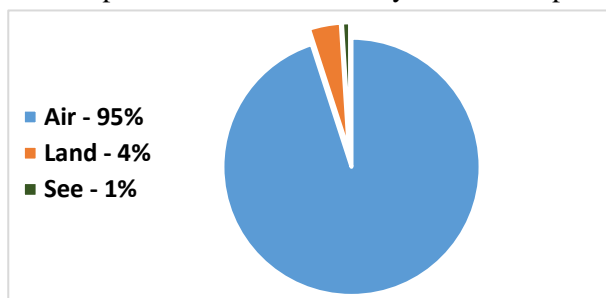
An important document that should be prepared by a military unit and civilian company providing transport services is the NDA (non-disclosure agreement). It is a

document containing a confidentiality agreement between the client and the contractor. The company is obliged to sign this contract in order not to disseminate data on the transported cargo. By signing such a contract, each party is obliged to prohibit all external information about the outsourcing agreement. It is best to make such an agreement in the second phase of the process, because then the principal is sure that no information will be made available to others.

The last document that is necessary for the implementation of outsourcing for the army is a public security certificate. The document confirms the credibility of the company through a certificate of protection of public information. The document also shows the date for which the certificate was granted and when the end of the term of the declaration expires.

The most common transport used for military entities is air transport, as shown in Figure 3. This is mainly due to the short transport time (Smal and Gajowiak, 2019).

Figure 3. The use of transport branches for the army on the example of Kuehne+Nagel



Source: Own elaboration on the base of data obtained from the company.

It is worth to add, that civil companies make a number of mistakes in the planning of transport services. The observations made show that the most common are¹⁹:

- errors in the completion of documents;
- incompetence of employees;
- poorly written contracts;
- concluding long-term contracts without the possibility of executing an order.

An example of a well-made large transport service is the movement of US troops in 2017 from America to Poland for military exercises pk. "Anaconda". It is described in details in the paper (Ibidem).

¹⁹Review with the Expert - Dariusz Janasz, Director for military purposes in Kuhne + Nagel Company.

For the purpose of the further research, the analysis of factors affecting the safety of transport processes, the search for dependencies between them, and the identification of shortcomings and possibilities to improve them.

As results from the research, the primary problem in ensuring the safety and reliability of the investigated processes lies on the side of the army, because people dealing with outsourcing in the army do not understand the fact that the military is not a priority client for civil companies. This is caused by a much larger number and regularity of orders received from civil companies than from the army. In the case of the PAF, a large number of errors were also noted when ordering transports, especially when compared to orders of other armies (Smal and Gajowiak, 2019). Table 2 presents the main differences between the conditions in the implementation of outsourcing transport for the PAF, the US Army and other NATO armies.

Tables 2. *Factors differentiating an outsourcing of transport services in case of different armies*

| Factors of outsourcing | Poland | USA | NATO |
|---|---|-----------------------------|----------------------------------|
| The period of submitting the offer | appr. 1 month | to 3 weeks | 2-4 weeks |
| Information flow | post | e-mail | e-mail |
| The number of documents required | a lot of documents | not many | one |
| The period of the service | short | long | long |
| The procedure for the service | not clear | clear | clear |
| Documents required before order (KRK, KRS) | yes | no | no |
| The required opinion about the company before the order | yes | no | no |
| Information flow | long | short | short |
| Using the ESPD ²⁰ | no | no | yes |
| Expenses of the company related to submitting documents in phase II | great | small | at all |
| Instructions for soldiers | no | yes | no |
| The profitability of the order | average | great | great |
| Possibility of teleconferencing to establish details or changes | no | yes | yes |
| Internet Tender | no | yes | yes |
| The most often transported equipment | weapons, ammunition, food, military equipment | military equipment and cars | military equipment and personnel |
| Fast contracting | no | no | yes |
| Confidentiality of the order | required | required | required |

Source: Smal T., Gajowiak N., *Safety and Reliability in the Management, Part 2: Evaluation of current solutions - practical approach.*

Comparison of the factors contained in the table clearly shows that cooperation with the PAF requires the most time and effort in preparing the offer of the transport

²⁰ ESPD – European Single Procurement Document.

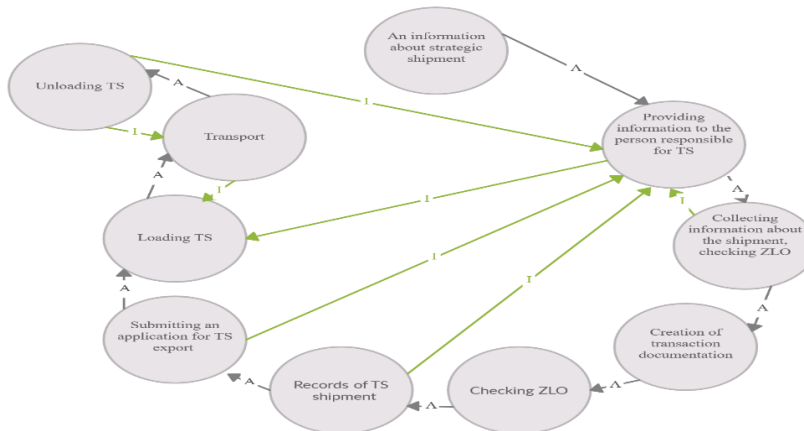
service. The first serious limitation is the method of communication between the client and the contractor. The PAF continues to use postal services and paper documents, which extends and increases communication costs. Another limitation is the required large number of paper documents and the related costs incurred before the order was received. In addition, the Polish side sends a lot of legal articles, regulations and standards that must be followed. Before there is specific information, people working on the contract spend a lot of time determining the details of the order.

The PAF should introduce the ESPD document, i.e., European Single Procurement Document. Such document is used in Poland by the Border Service, but not by the PAF. The completion of such a document in the second phase of outsourcing takes about 10 minutes and significantly simplifies the procedure for preparing the offer. The collection of all documents in the currently required mode takes up to 3 weeks, while in the ESPD document, the name of the company that wants to win the contract, NIP, scope of responsibility, company representative and its data, representative's position, permissions, etc. are filled in. Questions refer to the criminal record, financial situation company, financing of terrorism. Sometimes the question arises as to whether functionaries employ their children in a company or to cooperate with other companies. Only when the company wins the order may it be asked to provide all official documents, but then the company is sure that the expenses incurred will be returned as a result of the order.

6. Model of Strategic Goods Shipment by Air Transport

In order to improve the management of strategic goods transport, expert interviews were conducted, on the basis of which a model of this process was developed (Figure 4).

Figure 4. Model of the process of strategic goods shipment



Note: TS - strategic transport, ZLO - Integrated Deny List, A – Action, I - Information

Source: Own elaboration.

The first two stages take place inside the company that deals with the transport of strategic goods. The first stage, i.e., receiving information about a strategic shipment, is associated with sending the offer to companies that are authorized to provide transport services of strategic goods. Such an offer usually includes information such as: name and personal data of the client, name of the unit, terms of submitting offers (schedule of notifications and tenders), cargo specification, place of receipt and delivery of the cargo. In the second stage, the person responsible for the transport of strategic goods, depending on the company, may be, for example, an export control specialist.

In the third stage, a full cost estimate of the order is prepared, taking into account both administrative costs and the costs of the transport itself. In the case of companies that start cooperation with the Armed Forces, often at this stage the company has to prepare a set of documents needed to perform the service. This is necessary because the company must be verified in terms of applicable legal regulations, which are required when performing services for the army. At this stage, the initial planning of the means of transport appropriate to the specificity of the strategic goods is also performed. During this stage, a detailed plan of the entire project is also prepared. ZLO is also checked.

Information flows through all stages of the transportation of strategic goods. Any change that has occurred, be it on the client's or the contractor's side, should be communicated to the other party quickly enough so that the service can be fully performed. Information is usually transmitted via e-mail, but sometimes traditional e-mail is used, which generates delays and, consequently, an uninterrupted message.

In order to properly assess the management of the transport of strategic goods process in the context of their safety, in the next stage, the identification of sensitive events that may occur at individual stages of this process was carried out (Table 3).

Table 3. Identification of adverse events in the process of transporting strategic goods

| lp | Process step | Adverse events in the process of transporting strategic goods |
|----|---|--|
| 1 | An information about strategic shipment | Omission of important information, incomplete information; making a deal with a disloyal and unreliable partner; hindered contact between civilian entities and the Armed Forces; threats to confidentiality of data |
| 2 | Providing information to the person responsible for transport | Incomplete information, the use of traditional mail which generates delays |
| 3 | Collecting information about shipment, checking the integrated refusal list | The shipment is oversized, goods are declared that cannot be transported by air transport or their quantity excludes the possibility of such transport; lack of a suitable means of transport |
| 4 | Creation of transaction documentation | No consent to export TS, prolonged approval of export; incorrectly formulated or incomplete application |

| lp | Process step | Adverse events in the process of transporting strategic goods |
|----|--|---|
| 5 | Checking the integrated refusal list | The recipient is on the integrated refusal list |
| 6 | Record of strategic transport shipment | Strategic goods have been misclassified, the packaging has been incorrectly selected for the content transported, incorrect loading into the box (single loading unit), checking whether the shipment can be transported by passenger plane; emergence of costs not covered by the contract |
| 7 | Submitting an application for strategic transport export | Issuing incorrect shipping documents due to badly classified strategic goods, introducing the wrong recipient; emergence of costs not covered by the contract |
| 8 | Loading strategic goods | Damage to the shipment during loading, improper fastening of the load, loss of the shipment, theft of the shipment, the shipment does not fit in the hatch |
| 9 | Transport strategic goods | Incorrect securing of the goods, lack of suitable storage space, checking the internal control system of the company transporting strategic goods, failure of technical systems in the cargo hold |
| 10 | Unloading strategic goods | No proof of delivery, wrong place of unloading, no suitable place to store strategic goods |

Source: Own elaboration.

Then, by questioning the experts selected for research, it was determined how often the identified events occurred in their practice, establishing the estimated number of events for every hundred cases of the process of transporting strategic goods by air (Table 4).

In the case of standard statistical analyzes, for example based on road transport, there is no problem with a small number of research groups. However, the specificity of the transport of strategic goods is so unique that finding the right number of experts ready to determine the probability of individual events that may affect the safety of this type of transport is extremely difficult. It should be noted that the interviews were conducted only with people who managed or manage the examined processes in practice. Therefore, due to the high specificity of the considered processes and their very low repeatability, the research was carried out on a sample of seven people. These were people managing the processes of transporting strategic goods in civilian companies and in the army in 2010-2019.

The interviews were conducted in the period from February to April 2019. The people interviewed included officials from the institutions of the Ministry of National Defence of the Republic of Poland, Command of Transport and Movement of the Forces - Military Movement Coordination Centre, Command of the Special Forces Component, Logistics Brigade Transport Section, Airport Service Command and managers from companies implementing strategic transports for the army - Kuhne + Nagel and Panalpina.

Table 4. The incidence of adverse events at individual steps of the studied process based on experts' opinions

| The incidence of events on every 100 cases | Expert | | | | | | | Σ | \bar{x} | S | Me |
|--|--------|----|----|----|----|----|----|----------|-----------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | |
| The shipment is oversized | 90 | 90 | 85 | 85 | 90 | 85 | 80 | 605 | 86,4 | 3,8 | 85 |
| Goods that cannot be transported by air have been declared, or their quantity excludes the possibility of such transport | 10 | 10 | 7 | 5 | 8 | 10 | 10 | 60 | 8,6 | 2,0 | 10 |
| No suitable means of transport | 3 | 3 | 10 | 2 | 20 | 25 | 30 | 93 | 13,3 | 11,6 | 10 |
| No approval to export strategic goods | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,0 | 0,0 | 0 |
| Approval for export is late | 2 | 2 | 1 | 3 | 2 | 3 | 2 | 15 | 2,1 | 0,7 | 2 |
| Incorrectly formulated or incomplete application | 1 | 1 | 0 | 2 | 1 | 3 | 2 | 10 | 1,4 | 1,0 | 1 |
| The recipient is on the integrated refusal list | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,0 | 0,0 | 0 |
| Strategic good has been incorrectly classified | 10 | 10 | 7 | 10 | 5 | 10 | 10 | 62 | 8,9 | 2,0 | 10 |
| The packaging was incorrectly selected for the content being transported | 10 | 10 | 5 | 10 | 5 | 10 | 10 | 60 | 8,6 | 2,4 | 10 |
| The goods were incorrectly loaded into the loading unit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,0 | 0,0 | 0 |
| Incorrect shipping documents are issued for badly classified strategic goods | 10 | 10 | 2 | 10 | 5 | 5 | 2 | 44 | 6,3 | 3,7 | 5 |
| Bad recipient is introduced to documents | 2 | 2 | 0 | 1 | 2 | 3 | 2 | 12 | 1,7 | 1,0 | 2 |
| Damage to the strategic goods at the stage of loading | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 8 | 1,1 | 0,7 | 1 |
| Incorrect fixing of the strategic goods | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0,3 | 0,5 | 0 |
| Lack of adequate space for storing strategic goods in warehouses or security, etc. | 3 | 3 | 0 | 5 | 2 | 4 | 1 | 18 | 2,6 | 1,7 | 3 |
| Failure of technical systems in the hold (lighting, heating / cooling system) | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 13 | 1,9 | 0,9 | 2 |
| Damage to the strategic goods at the stage of transport | 3 | 3 | 2 | 5 | 1 | 2 | 3 | 19 | 2,7 | 1,3 | 3 |
| Lack "proof of delivery" | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,0 | 0,0 | 0 |
| Wrong place of unloading | 2 | 2 | 1 | 2 | 1 | 2 | 2 | 12 | 1,7 | 0,5 | 2 |
| Lack of adequate space to store strategic goods | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 4 | 0,6 | 0,8 | 0 |
| Damage to the strategic goods at the stage of unloading | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0,3 | 0,5 | 0 |
| Refusal to accept the shipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,0 | 0,0 | 0 |

Source: Own elaboration.

7. Statistical Analysis of Research Results

As part of the statistical data analysis, the following was calculated: arithmetic average- \bar{x} , standard deviation – S and median – Me . As a result of the conducted research, a relatively large convergence between the indications of individual experts was established. The most common adverse events in the process of strategic transport implementation are:

- oversizing the shipment;
- declaration of strategic goods that cannot be transported by air transport or its quantity excludes the possibility of such transport;
- no suitable means of transport;
- strategic good has been incorrectly classified;
- the packaging was incorrectly selected for the content being transported;
- incorrect shipping documents are issued for badly classified strategic goods.

In the conducted research there was a problem of a small research sample. A small statistical sample is often a challenge to the current design standard and analytical approach in research. This situation is typical for estimating and analysing the reliability of systems and processes (Bris and Soares, 2009). The size of the research sample affects the probability of a specific hazard and has an impact on the reliability of the results. Very often in the literature there is an approach that a small research sample is not sufficient to determine the probability that would be representative for determining the behaviour of the entire population. In addition, a small research sample is usually associated with low statistical power, overestimates the expected false-positive rate (first type error), overestimates the effect size, and shows low reproductive performance (Yi *et al.*, 2017).

Unfortunately, in many situations, as is the case with our research, it is not possible to carry out more statistical tests. There are such cases in the literature, for example in neurobiology (research on laboratory animals), medicine (research related to the use of magnetic resonance data, which is expensive) or testing the usability of computer software, where the statistical sample is often several units.

Therefore, to perform a statistical analysis for small research samples, various statistical parameters can be used, such as (measuringu.com, 2020):

- comparison - if it is necessary to compare values such as task completion conditions, task completion time or a rating scale for two independent groups, there are two procedures that can be used both in testing small and large statistical groups; the selection of the appropriate method depends on the type of data used for the analysis: fixed or discrete:
 - comparison of means - if the data is constant (not binary), two Student's t-tests are used on samples;

- two proportion comparison - if the data is binary (pass / fail or yes / no) then the two-ratio test is used. It is a modified version of the well-known chi-square test method (Sauro and Lewis, 2016).
- confidence interval- when you need to know what the possible range of population of units is based on a sample of data, it is important to create a confidence interval. While the width of the confidence interval is usually wide (usually 20 - 30 percentage points), the lower and upper limits of the ranges will provide information on how often a given phenomenon may occur in the entire population. Depending on what data we have, there are three different approaches for calculating the confidence interval:
 - confidence interval around the mean - if the data is continuous (not binary), such as the rating scale, dollar order size, or number of visits to a given website, the confidence interval is based on the Student t-distribution (which takes into account the sample size);
 - confidence interval around binary values - in case of answers to closed questions, the confidence interval obtained by Wald's method can be used;
- point estimation for means - depending on the purpose of the research, the best type of estimation, e.g., for the average task completion time, may be different.

The obtained results indicate a relatively high convergence of experts' indications. The relatively highest standard deviation was obtained for the following events: lack of a suitable means of transport and incorrect shipping documents for poorly classified strategic goods. This may indicate a fairly large difference in experiences between individual experts, which in turn is probably related to their place and period of work in the strategic transport system.

Interesting results were also obtained in the case of some adverse events, previously considered as possible by the authors (Tab. 3), because they were not indicated once by any of the experts surveyed. They included: The recipient is on the integrated refusal list, the goods were incorrectly loaded into the loading unit and refusal to accept the shipment.

This situation may result from the fact that these events are so important that, in principle, there is no practical possibility to allow them to occur in practice.

8. Conclusion

Based on the conducted research, it was found that:

1. The problem of managing the transport of strategic goods is poorly known and there is not too much research on this subject in the available literature. Moreover, transport processes in the area of strategic goods are irregular and they are also covered by trade secrets. All this makes access to research data very limited.
2. The outsourcing of transport services to military entities is carried out regularly and is an effective strategy to support the PAF in specialists and transport means, which the Polish army does not have in sufficient numbers.

3. It was established in the research that in case of the PAF, a large number of errors were noted when ordering transports (when compared to other armies), what may lead to decreasing safety of conducting such processes.
4. Companies that undertake transport services for military entities should be prepared as well, to secure side tasks such as catering, accommodation, security, loading and unloading, medical assistance, etc.
5. As a result of the research, the procedures for the implementation of strategic goods transport, including procedures for ordering transport from a civil company, were established. The incidence of adverse events that affect the safety of the implementation of the transport processes were also identified.
6. The conducted research will allow in the next stage to develop a detailed model of managing the transport of strategic goods in the context of its safety. They will also make it possible to estimate the level of risk in individual phases of the model and allow us to develop organizational solutions that eliminate or reduce the frequency of adverse events. The developed model will also be the starting point for the development of the concept of an IT system for the management of air transport of strategic goods.

References:

- Air Force Interservice Manual 24-204. Preparing hazardous materials for military air shipments. 11 December 2001.
- Association for safe international road travel <https://asirt.org/initiatives/informing-road-users/road-safety-facts/road-crash-statistics>.
- Belobaba, P., Odoni, A., Barnhart, C. (Eds.). 2015. The global airline industry. John Wiley & Sons.
- Biernikowicz, W., Milewski, R., Smal, T. 2010. Transport wojskowy w operacjach poza granicami kraju. Wyższa Szkoła Oficerska Wojsk Lądowych imienia generała Tadeusza Kościuszki.
- Bris, R., Soares, C.G. 2009. Homogeneity and scale testing for small samples with censored and missing data. In *Reliability, Risk, and Safety, Three Volume Set*, 941-948. CRC Press.
- Bris, R., Soares, C.G. 2009. Resilient organizations and resilient praxis—A review of current status related to safety. In *Reliability, Risk, and Safety, Three Volume Set*, 1163-1170. CRC Press.
- Bruneau, M., Chang, S.E., Eguchi, R.T., Lee, G.C., O'Rourke, T.D., Reinhorn, A.M., ... & Von Winterfeldt, D. 2003. A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake spectra*, 19(4), 733-752.
- Foster, H.D. 1993. Resilience theory and system evaluation. In *Verification and Validation of Complex Systems: Human Factors Issues*, 35-60. Springer, Berlin, Heidelberg.
- Ip, W.H., Wang, D. 2011. Resilience and friability of transportation networks: evaluation, analysis and optimization. *IEEE Systems Journal*, 5(2), 189-198.
- Janić, M. 2019. Modeling the resilience of an airline cargo transport network affected by a large scale disruptive event. *Transportation Research Part D: Transport and Environment*, 77, 425-448.
- Jałowiec, T. 2017. Specyfika zarządzania łańcuchami dostaw w sektorze militarnym. *Przedsiębiorczość i Zarządzanie*, 18(8.1), 111-121.

- Johnsen, S. 2010. Resilience in risk analysis and risk assessment. In *International Conference on Critical Infrastructure Protection*, 215-227. Springer, Berlin, Heidelberg.
- Koksalmis, G.H. 2019. Operations Management Perspectives in the Air Transport Management. *Journal of Business Administration Research*, v2(1).
- Majer, P. 2012. W poszukiwaniu uniwersalnej definicji bezpieczeństwa wewnętrznego. *Przegląd Bezpieczeństwa Wewnętrznego*, 7(4), 11-19.
- Milewski, R., Smal, T. 2018. Decision making scenarios in military transport processes. *Archives of Transport*, 45.
- Ministry of Foreign Affairs Republic of Poland. <https://www.gov.pl/web/diplomacy>.
- Pursiainen, C. 2018. Critical infrastructure resilience: A Nordic model in the making? *International journal of disaster risk reduction*, 27, 632-641.
- Sauro, J., Lewis, J.R. 2016. Quantifying the user experience: Practical statistics for user research. Morgan Kaufmann.
- Senguttuvan, P.S. 2006. *Fundamentals of Air Transport Management*. Excel Books India.
- Shpak, N., Dvulit, Z., Luchnikova, T., Sroka, W. 2018. Strategic development of cargo transit services: a case study analysis. *Engineering Management in Production and Services*, 10(4), 76-84.
- Smal, T., Gajowiak, N. 2019. Safety and Reliability in the Management of Civilian Transport Services for the Army: Part 2: Evaluation of current solutions-practical approach. In *2019 International Conference on Military Technologies (ICMT)*, 1-6. IEEE.
- Smal, T., Gajowiak, N. 2019. Safety and Reliability in the Management of Civilian Transport Services for the Army: Part 1: Organizational and law conditionings-theoretical approach. In *2019 International Conference on Military Technologies (ICMT)*, 1-6. IEEE.
- Smyk, S. 2007. Rola zewnętrznych oferentów usług logistycznych (outsourcingu) w logistyce wojskowej. *Logistyka*, wyd. Akademia Obrony Narodowej. Warszawa, 65-68.
- Straube, F., Cetinkaya, B.T. 2008. Trends und Strategien im Logistik management. *Kongressband*, 25, 38-39.
- Yi, X.J., Shi, J., Mu, H.N., Dong, H.P., Zhang, Z. 2017. Reliability analysis of repairable system with multiple-input and multi-function component based on goal-oriented methodology. *ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering*, 3(1).