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Methods of transporting loads with low transport susceptibility

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and

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Summary

The thesis deals with the transport of goods with low transport susceptibility. This work was undertaken due to the limited amount of up to date information on the transport of goods with low transportability, especially in Polish literature.

The main purpose of the work was to indicate the type of goods that are perceived as the most difficult to transport on the Polish and foreign markets. An additional objectives were aimed to indicate:

- whether the perception of the transport of goods with low transport susceptibility on the Polish market differs significantly from the perception on the foreign market;
- how companies perceive the difficulty of transporting goods with low transport susceptibility;
- difference between Polish and foreign market when it comes to transport of goods with low transport susceptibility;
- what type of cargo is perceived as most difficult to transport.

Research hypothesis was formulated as follows: Polish companies have more difficulty transporting goods with low transport sustainability.

In empirical research was applied questionnaire method. The survey covered companies dealing with logistics on Polish and foreign markets. The biggest research problem was getting a sufficiently large number of responses. Inquiries were sent to 580 companies and requests to complete questionnaires were repeated several times. The author estimates that the number of requests to complete the survey exceeded 1200. Finally as a result of survey, 40 completed questionnaires were received, which is 6,9% response rate taking into consideration number of companies.

The study proved that the size of the company does not influence perception of difficulties in transporting goods with low transport susceptibility. The goods that were considered the most difficult to transport were these that were harmful to human health. An interesting relationship appeared between the preparation of the company for transport of goods with low transport susceptibility and the perception of the difficulties of transport - the better prepared for this declared a company, the higher the difficulty of transporting goods was assessed. Research confirmed the hypothesis that Polish companies have more problems transporting goods with low transport susceptibility comparing to foreign researched companies.

Keywords: logistics, transport of goods with low transport susceptibility, transport, sensitivity of goods.

Introduction

Logistics has undergone significant changes throughout history, as transportation technology and infrastructure have evolved, and global trade has increased. In the past, goods were transported over long distances using animal-drawn carts and ships, and the transportation process was often slow and unreliable. Over time, the development of rail and road networks, as well as improvements in shipping technology, made it possible to transport goods faster and more efficiently. With the advent of air travel and the growth of air cargo, goods could be transported over long distances in a matter of hours, revolutionizing the way goods were traded globally. The rise of digital technology has also had a major impact on logistics, enabling real-time tracking and communication, and providing new opportunities for automation and optimization. The integration of technology has also led to the development of new business models, such as e-commerce and just-in-time delivery, which have further transformed the logistics industry.

In today's globalized economy, logistics plays a crucial role in ensuring the efficient transportation of goods from one location to another. However, the transportation process can be impacted by various factors, such as the susceptibility of the load to damage or degradation during transit. To address this challenge, various methods have been developed to transport loads with low transport susceptibility. This paper will provide an overview of these methods, including the benefits and limitations of each.

The aim of the work is to evaluate transport of goods with low transport susceptibility. In my opinion, this is an extremely important topic, because logistics and transported goods are at an increasingly advanced stage. The work consists of five chapters. The first one, entitled "Logistics", deals with the historical aspect and the very definition of logistics. Various methods of transport were also compared. In the second chapter, I described the sensitivity of cargo as well as the methodology, requirements and limitations in the transport of goods with low transport susceptibility. The third chapter describes the research methodology, and the fourth describes the results of the research itself and the correlations. The final chapter presents conclusions and observations.

1. Logistics - theoretical approach

1.1. Definitions of the logistics

Logistics can be defined in many ways, proof of this is the comparison of the definitions of many authors (table 1). Now I would like to present three definitions of different authors.

The dictionary of The Logistics & Supply Chain Management Society defines it in the simplest way– „*Logistics - is the management of the flow of goods, information and other resources between the point of origin and the point of consumption in order to meet the requirements of consumers*". Despite its simplicity, the definition is complete. Goods must flow as planned from one point to another for the recipient to be satisfied.

Dawid Lowe describes it as *"Total concept covering the planning and organizing of the supply and movement of materials/goods, etc. from original source through stages of production, assembly, packing, storage, handling and distribution to final consumer"*. Although it seems longer and more complicated, it still describes the same thing - Moving goods from point to point in a certain order so that the recipient is satisfied.

Chaberek M – "*Logistics from the real side is a process aimed at servicing every rational human activity aimed at the implementation of any goal, consisting in providing the necessary resources in the right place and time, in the right amount and with the right quality, and at the right cost (price), in such a way that all activities of realizing the main goal are carried out in an effective, efficient and beneficial way* ". The word "right" appears several times in this definition.

In fact, logistics could be defined in a simplified way by the 7R rule:

- Right product.
- Right quantity.
- Right condition.
- Right place.
- Right time.
- Right customer.
- Right price.

If these seven points were to be combined into a grammatically correct sentence, we would get a definition very similar to these quoted above.

All these definitions in the table below, although different from each other, describe the same thing. From each one we can identify the same certain “keywords:

- Goods/resources/information.
- Planning/management/timing.
- Movement/flow.
- Meeting the requirements.

All 7R keywords and principles seem to be equally important. But if I were to define two keywords that would come closest to the meaning of logistics, it would be "flow" and “planning”. The logistics specialist focuses mainly on planning appropriate, safe and planned traffic so all that 7 rules are met. So why in my opinion are these two words so important? Without proper planned movement there is no right product, quantity, condition or place, the goods are not on time, and sometimes they even end up in the wrong place (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, P.11)(CHRISOPHER 2022, P.4-9).

Table 1.

Definitions of Logistics

Source	Definition
S. Niziński, J.Żurek, 2011, *Logistyka ogólna.*	Logistics is an integrated system for planning, managing and controlling the structure of material flows and the information and capital flows coupled with them in order to optimally create and transform values (goods)."
S. Niziński, J.Żurek, 2011, *Logistyka ogólna.*	“Logistics is all activities related to the planning, implementation of the time-spatial transformation of goods from the place of production to the place of consumption (use).”

Beier F.J.: Logistyka. Szkoła Główna Handlowa, Warszawa 2004.	"Logistics is a concept of process management and potential for coordinating the implementation of goods flows on the enterprise scale and links between its market partners."
D. Lowe 2002 Dictionary of Transport and Logistics.	Logistic – "Total concept covering the planning and organizing of the supply and movement of materials/goods, etc from original source through stages of production, assembly, packing, storage, handling and distribution to final consumer."
Chaberek M. (2011), Praktyczny wymiar teorii logistyki, „Roczniki Naukowe Wyższej Szkoły Bankowej w Toruniu", nr 10.	„Logistics from the real side is a process aimed at servicing every rational human activity aimed at the implementation of any goal, consisting in providing the necessary resources in the right place and time, in the right amount and with the right quality, and at the right cost (price), in such a way that all activities of realizing the main goal are carried out in an effective, efficient and beneficial way."
Krawczyk, 2000, s. 33 *Logistyka w zarządzaniu marketingiem*, AE Wrocław.	"Logistics includes planning, coordination and control of the course in terms of both time and space, real processes in which the organization participates, in order to effectively achieve the goals of the organization."
Dictionary of The Logistics & Supply Chain Management Society.	"Logistics - is the management of the flow of goods, information and other resources between the point of origin and the point of consumption in order to meet the requirements of consumers."

ILT Supply-Chain Inventory Management SIG.	"Logistics - The time-related positioning of resources to meet user requirements."
Oak Brook (1985), What's Is All About?	"Logistics is a term that describes the process of planning, implementing and controlling the efficient and economically effective flow of raw materials, materials for production, finished products and relevant information from the point of origin to the point of consumption in order to meet customer requirements."
Ciesielski M. (2010), Strategie logistyczne przedsiębiorstw.	Logistics deals with the flow of materials, work in progress, finished goods, and goods, as well as related information streams and the accompanying cash flows.

Source: own study based on research

If I were to create my own definition of logistics, I would have formulated it like this: "Logistics is the planned movement of tangible or intangible goods so that they reach their destination at a specified time and in an agreed condition, quantity and price".

1.2. Logistics in history

If we were to find the first appearance of the word logistics, it would appear in ancient Greece. The Greek word for logistics is "logistike", and it means "the art of counting". The word itself consists of two merged terms, *Logos* - which means "thought" and *Logike* which means "logic". Only recently has logistics ceased to be associated mainly with the military. Before 1950, logistics was not as important to economic circles as it is now (MAŚLOCH 2005, p.35) (BALLOU 2007, p.4).

A great example of the use of logistics in ancient times is the Roman army. It might seem that in such distant times, logistics would be very rudimentary. This is certainly not true state of affairs. It is also great evidence of the evolution of logistics even in such an

ancient period of time. The means of transport in the Roman army can be divided into two “groups”. The first of them were soldiers and the second was the auxiliary staff. The group "soldiers" does not need any explanation. The second group: "auxiliary staff" are servants, slaves and pack animals. Their task was to carry equipment, provisions, spare weapons, armor and everyday items. Depending on the situation, these two groups could exchange the amount and type of goods carried. In some cases, when quick movement from place to place was needed, the soldier only carried his weapons and armor. In the event of shortages in the support staff, some equipment was transferred to the soldier. The equipment itself, and more importantly the way of transporting it, was already standardized then. Clearly defined what and how to carry certain items. For example, a soldier's package had to be hung on the top of a shield to achieve the proper center of gravity.

However, it was the aforementioned second group that was the real logistics base. Staff and animals created "trains" which differed in purpose and type of transported goods. Such "trains" were assigned to specific groups, some transported the resources of a given unit of soldiers, some officers, and others siege equipment. Nothing unnecessary was transported, it was determined how much food and equipment a human, horse or draft mule needs on average. The generals managing the Roman army also understood the importance of supply lines and warehouses, However, as in war, resource security was a priority, so the warehouses were partly strongholds and supply lines well-guarded. Even the ancient Romans understood that planned displacement allowed them to gain a huge advantage. A huge number of roads, bridges and canals were built by the Romans to allow easy transport of supplies. Later it also had an additional advantage - it facilitated trade in times of peace. (ROTH 1999, p.7-157)

Now I would like to describe shortly the logistics right before 1950. It is about the occupation of Germany by the United States immediately after the Second World War, in the years 1945-1949. Logistics is still military-related, but in post-war times. Since ancient times, little has changed, the military is still an example of an organization that cares about optimizing operations and minimizing costs. With the advancement of technology, it was possible to determine exactly what was needed and in what quantity, various types of transport were also available. This allowed, for example, to determine exactly what amount and type of food a person needed to stay healthy and strong. The main method of transport was sea freight, as it is the cheapest form of transporting large amounts of goods over long

distance, and the airports were created for the needs of fast transport of goods and important people (KRUGER 2017, P.105-163).

Looking at how logistics works in the army, the 7R principle comes to mind again. The proper equipment (right product) must go to the right place where it will be picked up by the soldiers (right customer). Supplies cannot be destroyed or taken over by the enemy (right condition). Supplies such as provisions and ammunition must arrive at the right time and in the right quantity. Of course, it is arrive at the lowest possible cost, and in the case of war, it is not just money (right cost). Means of transport have been created or modified for the purposes of transport in war conditions. Armed trains, aircraft carriers, and armored personnel carriers are great examples of the fact that carrying the right goods requires the right tools. Immediately after the war, many entrepreneurs were content to satisfy the post-war demand for goods. But very quickly the increased access to information after the Second World War, allowed for some kind of insight into the operation of the military. 1958 was a time of economic recession in the US. So it was natural that entrepreneurs were looking for a way to cut costs. A zone that was largely overlooked so far by everyone except the military was spotted very quickly. Broadly understood logistic planning, which until now was the domain of the military, has become the main opportunity to increase profits. Transportation of goods in huge quantities at once has become the standard. Large trucks, usually associated with the military, began to be used for the transport of everyday products (J.BEIER 1995, p.20).

1.3. Means of transport

Different types of transport have developed over time. Many of them were created along with an increase in the technological level. However, their purpose has not changed over the years - transporting people, materials and information. In times that have been left, what method of transport will be used is dictated by a multitude of factors, from the time of transport, to the means of the aid. Very often one form of transport is not chosen, but several, it is multimodal transport. Goods are often used for a large part of the journey, and then transferred to another transport in the port (STOLARSKI 2005 p.17) (MENDYK 2002, p.114-119), (POPIOŁEK 2003, p.7-9).

Road Transport

Road transport is the most popular form of transporting goods. It is characterized by a relatively low cost of transport, high density of roads. With a good distribution. It also enables the transport of virtually all types of cargo, and in many cases it is not required to be reloaded to another type of transport. However, they have a low payload and a high accident rate. Another disadvantage in the case of oversized loads is not always the appropriate road infrastructure (POPIOŁEK 2003, p.28-30) (STOLARSKI 2005 p.31) (MENDYK p.124-125, 2002) (KRUPA 2017, p.20).
The picture is the best way to illustrate the means of road transport.

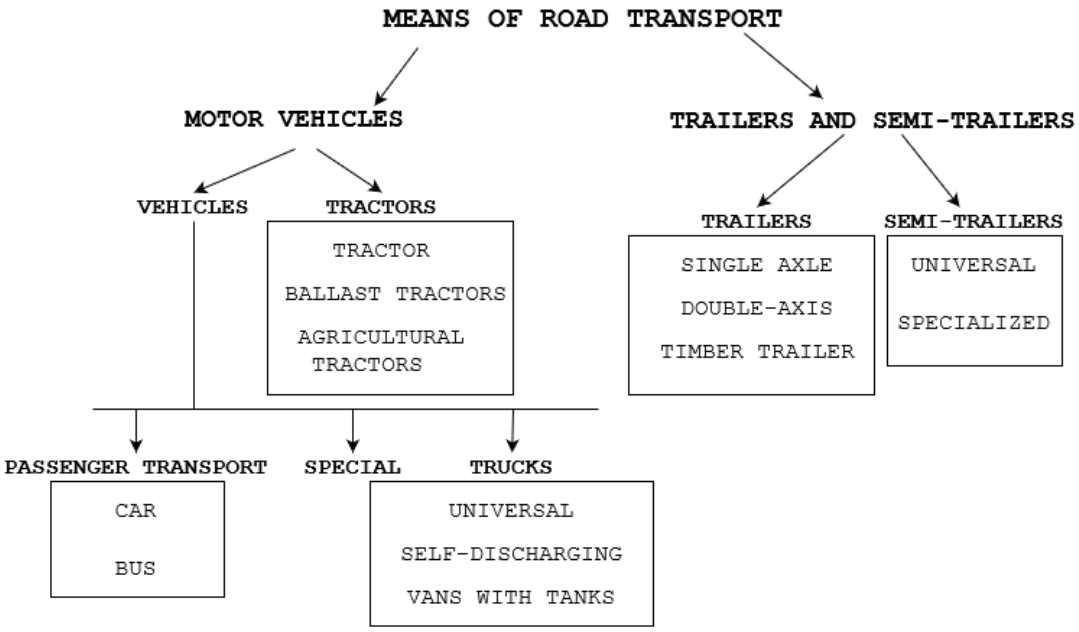


Chart 1. *Means of road transport*

(Source: own study based on Stolarski p.20)

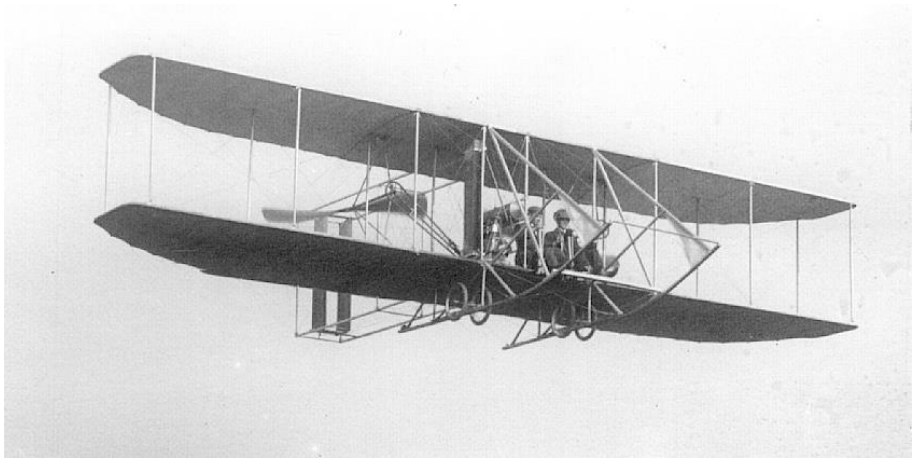
Road tractors and trucks are the most popular vehicles for the transport of goods in road transport. Trucks are vehicles with a permissible weight of 3.5T with a independent body. They do not require an additional trailer, but can be equipped with it. Most of such vehicles are universal vehicles, i.e. vehicles that allow the transport of all goods, except for special ones. On the other hand, special vehicles are used to transport one type of cargo, while specialized vehicles are used to transport one type of cargo (POPIOŁEK 2003 p28-30) (STOLARSKI 2005, p.31) (MENDYK 2002, p.124-125) (KRUPA 2017, p.21).

Road tractors are vehicles that do not have a separate body. To transport loads, a trailer must be connected. We can divide them into:

- Saddle Tractors: To which the semitrailer is attached.
- Ballast Tractors: Towing heavy-duty trailers.
- Agricultural Tractors: Intended for the transport of crops, but can also tow trailers with a standard body.

Air Transport

Air transport is one of the youngest modes of transport. It is assumed that air transport began in 1910-1911, when the US Post Office suggested the use of airplanes to deliver letters. However, it was the end of the First World War that pushed this mode of transport forward. The planes used during the war were much more efficient than their pre-war predecessors. Some businessmen acquired such machines to create the first commercial airlines. It might seem like a great move because the planes were bought back from the army for next to nothing. As it turned out later, the cost of maintenance was very high. This forced the civilian air branch to modify aircraft for specific purposes. It also became necessary to create an appropriate infrastructure such as: airports, workshops and air traffic control centers. This can be considered the beginning of air transport as we know it now. A major step forward was also the invention of the jet engine, thanks to it, large planes such as the Boeing 707 are now fly in our skies. The first transport flight took place in 1910 with the "Wright Model B" airplane, it carried 200 pounds (approx. .90 kg) on a distance of 105 km. Currently, the largest transport aircraft is the Antonov An-225 Mriya, capable of carrying up to 250,000 kg of cargo (SALES 2016, p.19-24) (TAYLOR 1972, p.898).



Picture 1. First transport flight

(*source: https://www.wright-brothers.org/Information_Desk/Just_the_Facts/Airplanes/Wright_Airplane_images/Model%20B/1910_Model%20B_flying.jpg*)

However, it is a very expensive form of transport. For example, the transport of a 40 "HQ (65 m3) FCL container from Shanghai to Gdańsk. Using road transport would cost 487$. By air transport it will be as much as USD 8,800[1].

Another disadvantage of air transport is the relatively small number of airports - 17,678. This necessitates the use of combined transport in many cases. Of course, not all airports are adapted to receive cargo. The main role of some of them is to pick up passengers. But some airports, for example ones in Liege, Cologne or Frankfurt, are aimed at picking up goods.

The great advantage of air transport in transport is its speed. This has a lot of application in the "just in time" methodology. It enables transport in emergency situations, e.g. in the case of missing key materials in the factory. It is a great carrier of perishable substances. Air transport is also the safest form of transport (SALES, 2016 p.7) (KRUPA, 2017 P.27)(CENTO 2009, p.4-5).

We can divide flights into three types:

Passenger: The main role is to carry passengers from place to place, the transport of goods in this case is a secondary matter - here the additional cargo is mainly the passengers' belongings, although in some cases other loads are taken.

[1] https://transportchiny.pl/wyceny_transportu_z_chin.php 13.03.2021

Combined: Transports both passengers and additional commercial cargo.

Transport: Their main task is to transport cargo, transport of human passengers is limited to necessary minimum – workers and pilots.

Water Transport

It's hard to pin down one single event that started the water travel. A great example of water transport can be found in Egypt. The River Nile was not only a source of water, it was also a very busy transport route. Undoubtedly, a great step in the development of transport was the invention of a sail that allowed traveling without the use of human work. However, if I were to point out something that would resemble how we define sea voyages now, it would be a Polynesian catamaran. Measuring up to 15 meters in length and able to take a crew of up to twenty people on board. They were the first water units that could travel thousands of miles of open water. The development of ships (as well as everything we know) has been driven by the war machine for centuries. Greek and Roman warships were equipped with both a sail and two rows of oars, which greatly facilitated maneuvering in the event of unfavorable winds. Moving several centuries into the future, the group of people who efficiently used sea transport were the Vikings. They used ships called longships to cover enormous distances, they had a very flat bottom. In this way, they allowed both river and sea transport, without the need to reload cargo and people. Another milestone was the invention of the compass for navigation, and the earliest record of such an invention dates back to 1180. The ship Santa Maria in 1492 moored off the shores of the new mainland - America. The ships grew, mainly for war purposes, and in 1637 the "Souvenir of the sea" - a war galleon over 50 meters long - left the British dock. For centuries, a ship equipped with a sail was the only form of transporting materials across vast bodies of water. However, the year 1783 was to slowly initiate a change of this state of affairs and the first steam-powered ship was built. However in the beginning, accidents happen - mainly due to the exploding boilers. Despite this, steam age greatly accelerated the sea journey. Originally powered by coal and wood, the steamers were modernized to run on liquid fuels. Maritime transport has come a long way, from tiny boats on rivers to today's huge container ships (MENDYK 2002, p.138-140)(CASSON 1964, p.3–249) (KRUPA 2017, p.29)(MCGRAIL 2002, p.431-436).

Sea transport is the most economical transport in the world, it enables the transport of a huge amount of goods. There are also virtually no restrictions as to the type of cargo to

be transported, a huge number of specialized ships sail in international waters, from icebreakers to tankers and container ships. However, it must be admitted that water transport is the slowest form of transporting goods. It is also obvious that water transport cannot take place without water (?). In most cases, it is impossible to deliver the goods directly to the recipient, it is necessary to use another method of transport. Huge ships also require a sufficiently large port to be able to moor. The selection of a ship depends on the needs, both on the requirements of the transported goods and economy (MENDYK 2009, p.138-140) (KRUPA 2017, P.21-30)(RAUNEK 2019, p.31-35).

Most popular types of transport vessels:

- Container Vessels -Used to transport goods in standard containers. Adapted to receive loading at adapted ports. Cargo locked in containers is transported aboard and below deck on these ships, so cargo space has increased significantly. The smaller ones are usually equipped with their own equipment, allowing them to unload in unsuitable ports. The largest, in turn, travel only on intercontinental routes and only call at large ports, so-called hubs, where the cargo left behind is transported by smaller ships to the destination port.
- Bulk Vessels -Used to transport dry goods such as, for example, various types of grain, coal. Loaded by conveyor or pump.
- Reefer Vessels - A reefer vessel is a vessel that transports perishable goods. It is constructed to maintain different temperatures in each compartment of the cargo hold depending on the product being transported. Furthermore, not only can the proper cooling temperature be set, but the transport can be planned so that the atmosphere in the hatchery allows some fruit to ripen during transport. Reefer ships are increasingly used to transport containers and special reefer containers. Reefer ships mainly used to transport food such as meat, fish and fruit.
- Tanker Vessels -With their help, all kinds of liquids are transported, mainly they are used to transport oil. But they are not limited to it, very often they transport dangerous liquid chemicals onboard. Loading and unloading on such vessels is carried by a system of pumps and pipelines for convenience and safety.
- Multi-Purpose Vessels - They are used to transport all kinds of goods. They are very universal, used when you need to transport smaller amounts of various goods.

Ports

Ports serve as a transfer point in the supply chain, but they are often places where factories, petrochemicals, other industrial facilities and logistics points operate. The proximity to the port ensures easy access to goods and shortens the distance in the supply chain. Over 80% of goods are transported by sea. To ensure the smooth flow of this amount of material, efficient ports are essential (GEERLINGS, KUIPERS, ZUIDWIJK 2018, p.8-14) (KRUPA 2017, p.45-47) (NOTTEBOOM, PALLIS, RODRIGUE, 2022 p.184-185).

We can define a port as:

> "*An economic facility located at the interface between the land and the sea, adequately prepared in terms of technology, technology and organization to handle trade turnover by sea, as well as to support sea and land transport means involved in their transport*" (KRUPA 2017, p.46).

One of the least-mentioned features of a port is that they are also a buffer. Ships that carry goods counted in thousands of tons are able to "hold" the goods like a large warehouse, if the need arises. Also, the ports themselves usually have enormous storage space. Which also translates into an increase in the supply chain buffer. As it is not uncommon for logistics-related outposts to be established within the ports, it can be said that there is some added value here. Within them, products can be processed, sorted and separated. Which of course generates added value for many companies. The strategic value of a port is determined by how many units it is able to move in a given unit of time, how large ships it can handle and, of course, the geographical location. Ports can be divided depending on the goods that flow through them. In dry ports the main type of goods are “dry”, those are usually grain or coal. Wet ports are mainly those that deal with good such as oil and other chemical liquid substances. Non bulk ports are the main stopping point for ships carrying containers and other non-bulk goods (GEERLINGS, KUIPERS, ZUIDWIJK 2018, p.8-14) (KRUPA 2017, p.45-47).

2. Cargo – main reason of logistics

The cargo is the main subject of the logistics process, it is the need to transport goods from one place to a destination in the most efficient way that contributed to the emergence of the field of science which is logistics. While transporting a cargo we have to be aware of the damages, that wrong transport technology could inflict. An example of such, could be a use of not sufficient durable packaging. One of the most basic transport tasks is to protect the cargo during the transport (right condition). This forces us to use an adequate method of transport. Organizing and choosing such a method of transportation depends on the cargo at hand. Different types of cargo demands different treatment. For example you have to protect highly flammable cargo from heat. So in order to transport those goods that require such protection, a safe container of some sorts must be precured, a specific loading/unloading procedures and machines must be used. Transport isn't always about just technical means, in addition, cost of the transport must be calculated and appropriate documents must be filled. In order to choose the most appropriate method, we have to think about the type of cargo that will be moved. Cargo can be divided by different criteria's. Some loads can be described by methods that needs to be used to transfer them from one place to another, for instance – lifting a container, in case of this category the most typical ones are hauling, pouring, filling and lifting. The most basic one is of course the size of the load, those can be categorized as small, full and oversized. Technical transportability is the one that describes cargo external features such a as shape and size and properties such a state of matter and by that we can categorize the cargo. We can also categorize the cargo by economic susceptibility, it describes the value allocated to the transportation of the cargo to the value of the cargo, so in simple words describes how profitable it is to transport given cargo. The last category is the natural transport susceptibility, it describes how easy it is to transport given cargo based on its natural characteristics, some good for instance have a very good resistance to outside conditions such as rain for example thus they are more susceptible to transport (LELEŃ, WASIAK 2017, p.163)(MENDYK 2009, p.221 2009)(MOKRZYCZAK 1985, p.2-3.

2.1. Attributes of loads

Different goods have different physical, biological or chemical traits. Knowledge about those traits allow us to choose appropriate means of transport, package and means of loading and storing inside a transport area. In case of loads highly sensitive on external condition allows to choose an appropriate conditions, in order to ensure safety of the cargo and outside environment. The most important traits are physical structure, consistency, density, melting point, freezing point, boiling point, bending strength, compression strength, content of individual components. Each of those attributes dictates different kind of conditions in with cargo has to be transported. For instance low melting point or boiling point forces use of refrigerators or other equipment that can sustain a appropriate temperature. Goods with high density are often very heavy and therefore risk of damaging other goods is a very common occurrence (LELEŃ, WASIAK 2017, p.162) (MOKRZYCZAK 1985, p.3) (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, p.11).

2.2. Loads sensitivity

Loads sensitive to mechanical energy

Sensitivity to mechanical energy depends on packaging of the cargo, technological processing, physical structure and chemical composition. We can distinguish two kinds of impacts on loads, simple and complex.

Simple - those are continuous acceleration, unidirectional, vibrations, shocks, impacts, free fall, thrust. Continuous unidirectional acceleration is a quantity whose direction of action on the load does not change much for a long time. This type of exposure occurs when the means of transport moves away or changes acceleration. Vibrations most often arise from the drive system - engine, drive shaft and wheels. Although the acceleration values in vibrations are small, they have a destructive effect on the load. Impacts most often occur during loading works. The result of free fall is the impact of the package on the stationary, rigid substrate. This type of exposure occurs during storage and transport, e.g. when a load drops from a certain height to the floor. The thrust occurs when loads are transported by open means of transport at high speed (air resistance).

Complex- mechanical exposures occur during the simultaneous action of several simple exposures, e.g. vibrations and acceleration. Those can also differentiated by time and

intensity of exposure such as short occurring, long occurring with stable intensity and long occurring with variable intensity. (LELEŃ, WASIAK 2017, p.162) (MOKRZYCZAK 1985, p.3) (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, p.11).

Light sensitive loads

Under exposure to light some types of cargo undergo chemical changes. These exposures may alter properties of the cargo and therefore changing it default condition. This applies mainly to lacquers, dyers, medicine, rubber. To prevent those unwanted changes, a limitation or even total isolation from light is required. The most important role here has the packaging, its protects the cargo even during the loading and unloading phases when protective barrier of the container is not applicable (MOKRZYCZAK 1985, p.3) (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, p.25).

Loads sensitive to moisture

These types of cargo are adversely affected by a high degree of humidity. A large factor in the case of such loads is their natural hygroscopicity. Corrosion can be an example of the adverse effects of moisture. Usually, hygroscopic loads should be transported and stored in conditions with a relative air humidity not exceeding 70%. Appropriate packaging plays an important role in isolating moisture from the goods (LELEŃ, WASIAK 2017, p.163) (MOKRZYCZAK 1985, p.3) (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, p.25).

Temperature sensitive loads

These are loads that are adversely affected by temperature changes. The most common example is frozen food. The refrigerators are used to prevent degradation of cargo properties during transport. Degradation refers to things such as melting, loss of properties, damage to structure of the material. Fast unloading and loading of the cargo is crucial, because it is the time when the cargo is most exposed to the unwanted conditions (LELEŃ, WASIAK 2017, p.163) (MOKRZYCZAK 1985, p.4) (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, p.26).

Live cargo

Each type of live cargo requires the appropriate type of transport and loading technology. Changes in the environment during transport have a negative effect on live animals. Shocks, overloads, and speed changes can cause stress and panic. In panic, they can

hurt themselves or other animals. Animals are loaded according to their type, e.g. horses are loaded parallel to the direction of motion. It should also be remembered that for long journeys, space for feed and supervision are essential (LELEŃ, WASIAK 2017, p.163) (H.mokrzyczak 1985, p.5).

It is worth mentioning that in the case of transporting such goods in containers or semi-trailers, they constitute an additional layer of protection against external factors. During loading and unloading, such goods are most exposed to external factors and it is during this time that special care should be taken (LELEN 2017, p.163) (MOKRZYCZAK 1985, p.4) (KORZENIOWSKI, SKRZYPEK, SZYSZKA 2001, p.26).

2.3. Transport of loads with low transport susceptibility in road transport

Transport of dangerous cargo

The transport of dangerous goods is one of the most regulated by law. For good reason, of course. If an accident occurs during the transport of such goods, the undesirable consequences are very significant. The transport of goods with status transport control requires the same method of compliance control with the same management control. In Poland, the share of dangerous cargo in the total cargo transferred is 10-15% of which 70% is transported by cisterns. In the Polish territory, dangerous goods transported by road accounted for 88-90% and only 8-10% was transported by rail transport. In Polish law, Article 87 on road transport clearly states that in the case of special transport it is necessary to obtain an appropriate permit. In the case of international transport, a special permit must be issued by each country in which the transport takes place. The international legal act on the transport of dangerous goods is the ADR act, local law supplements this act (but cannot violate it), it is the basis on every continent. Appropriate legal acts are necessary to maintain the highest possible road safety. Dangerous materials must be transported safely, that is, the substances must be isolated from unfavorable external conditions. This is done by using appropriate tanks, containers and containers. Additionally, a driver transporting hazardous materials is required to have the appropriate qualifications. In order to protect people, the transported material and the environment, it is necessary to provide additional equipment to protect against the undesirable effects of contact with the load (ŻABIŃSKI 2018 p61-69)

(Bugayko 2020 p.106-110) (Nyszk 2019 p.405). The most important ones can be mentioned here:

- a suitable type of fire extinguisher, adapted to the extinguishing of the transported material;
- appropriate protective equipment - gloves, goggles, clothing whose protective properties will effectively protect against contact with the transported material;
- first aid kit;
- equipment enabling the isolation of the environment from the adverse effects of materials - eg liquid absorbing agents, containers adapted to collect the material in the event of its spilling out of the transport space;
- appropriate tools for plugging the gully openings.

Dangerous materials are those that are legally labeled with such a mark. These are chemical substances and preparations as well as materials containing harmful substances that may endanger the safety of people and the environment exposed to them. ADR Convention in Annex "A" and lists such materials (ŻABIŃSKI 2018, p.63) (NYSZK 2019, p.407-408).

These are:

1. Explosive materials and objects
2. Gases
3. Flammable liquids
4. Flammable solids
5. Oxidizing materials
6. Poisonous materials
7. Radioactive materials
8. Corrosive materials
9. Various hazardous materials and items

However, in Annex "B" it clearly defines:

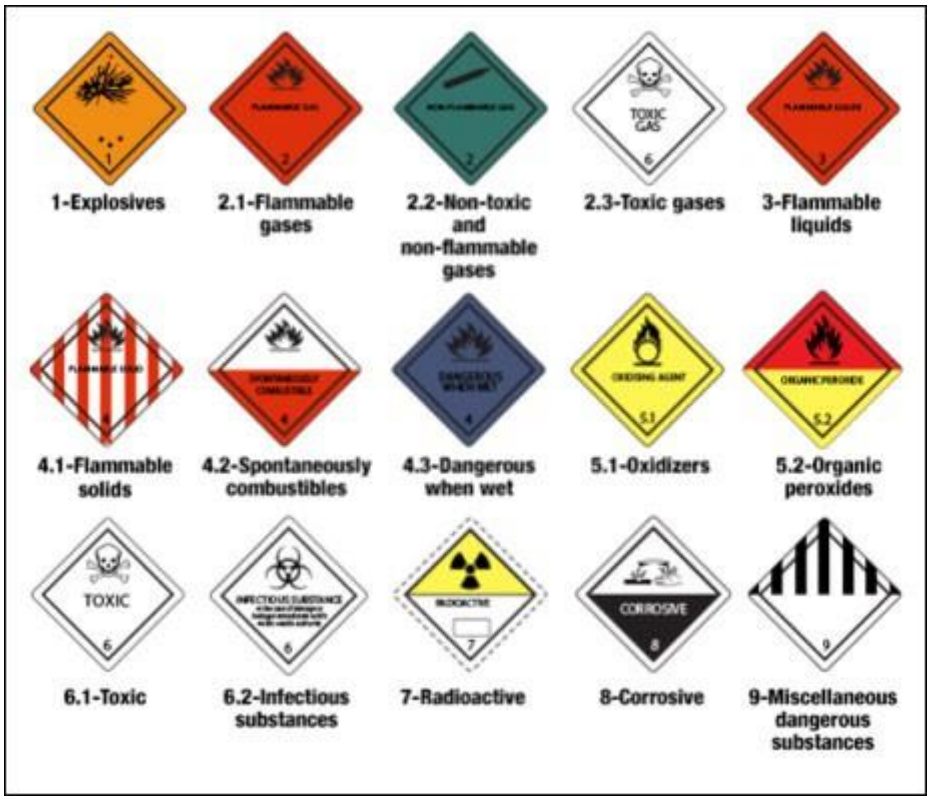
cconditions for the carriage of dangerous goods

• Conditions for marking vehicles with their additional equipment

• Technical conditions of motor vehicles, trailers, tanks and containers

• Documentation necessary for transport
• Requirements for people involved in this type of transport
• Conditions for unloading and loading these materials
• It is forbidden to load goods together in one vehicle

Cargo containing dangerous goods must be properly marked. This allows for the selection of appropriate remedial measures for the security services in the event of an accident (ŻABIŃSKI 2018, p.67) (NYSZK 2019, p.408) (ROGALSKI, PYZA 2018, p.352-354). The plates on such a load are diamond-shaped and are as follows:



Picture 2. ADR signs

Source: https://www.transportsfriend.org/dangerous-goods/hazard-signs-classifications/

Transport of oversized goods

Oversized loads are one of the most noticeable on the roads. The large size of the cargo and the way it is transported often draw attention. Oversized loads are characterized by dimensions - usually, weight and shape deviating from standard loads. For the weight deviating from the norm in the road transport, we assume the weight exceeding 25 tons, for example heavy machines. Each load the dimensions of which are larger than the standard transport unit, e.g. semi-trailers, are defined as oversized, they exceed the outline of the vehicle, most often we can observe here wind turbine propellers. Of course, the load can be characterized by all the above-mentioned attributes. The transport of oversized cargo is associated with similar procedures as in the case of the transport of dangerous goods. Here too, knowledge of transport methods and legal procedures is essential. In addition, it is also necessary to properly plan the route of such cargo. Due to the fact that this type of cargo, in many cases, whether due to its weight or size, cannot always travel the shortest route. This is due to, among other things, weight restrictions on bridges or the width of streets. Very often, in the case of mapping a route that meets such conditions, the designated person checks the route before departure. This is especially important for such loads as the transport vehicles have limited maneuverability and are often unable to turn freely in the event of complications. The safest way out is to use motorways and expressways whenever possible. In order to eliminate the risk of abnormal transport, a pilot moves in front of the transport vehicle, whose task is to ensure road safety for all road users. In most countries, a given type of road has a maximum load on the driving axle of the vehicle and as in the case of dangerous goods, it is necessary to obtain the appropriate permission to move on a given road section. Vehicles, just like the load, are often non-standard, we can distinguish vehicles with a longer wheelbase, a greater number of axles or vehicles equipped with an axle with greater torsional parameters or even equipped with several steering axles (LISIK, ZBROJA 2020, p.118-120) (MACIOSZEK 2020, p.134-137) (KRIVDA, PETRU 2021, p.425-427) (KOŁODZIEJCZYK, SKOWROŃSKA 2020, p.4-7)(CHMIELIŃSKI 2017, p.151-152).

Picture 3. Vehicle transporting oversize cargo.

Source: https://www.eu-transport.pl/transport-ponadgabarytowy/

To transport such loads, it is necessary to use appropriate trailers or semi-trailers. These are larger size units with additional capabilities. Often the semi-trailers are modified or made specifically for a specific load (LISIK, ZBROJA 2020, p.118-120) (MACIOSZEK 2020, p.134-137) (KRIVDA, PETRU 2021, p.425-427) (KOŁODZIEJCZYK, SKOWROŃSKA 2020, p.4-7).

Time-sensitive goods

Time sensitive goods are those whose properties or quality may deteriorate over a long period of transport. The most common sensitive goods are drugs, explosives, chemicals, plants and food, which are the largest group among these loads. Such goods, unless they are transported over a very short distance, cannot be transported by standard means of transport. For the transport of these goods rolling stock is used, equipped with appropriate technology, which does keep the load in appropriate climatic conditions. Usually these are adequate cooling units keeping the temperature, humidity and gas concentration at the appropriate level to prevent degradation. Containers containing such goods are very often equipped with

sensors to monitor the condition of the climate in the transport unit. Due to the risk of human health, in the case of contact with spoiled product, constant control and the necessary documentation are necessary. This is very well illustrated by the case of food transport, where the list of requirements is very extensive. These are, among others: (KONECKA, STAJNIAK, SZOPIK 2017, p.165-165) (LELEŃ, WASIAK 2018, p.439-444) (SATORA, SZKODA 2019, p.86-p89):

• Certificate of the quality of food products.
• Certificate of the technical condition of the cold store - ATP certificate.
• Decision allowing the means of transport to transport food.
• Determination of the driver's ability to transport food - a certyfication for sanitary-epidemiological purposes.
• Driver's examination card for the carriage of S-S sticks.
• Driver's medical book.
• Vehicle sanitary inspection book.
• Vehicle disinfection certificate.
• Temperature measurement printout np (KONECKA, STAJNIAK, SZOPIK 2017, p.165-165) (LELEŃ, WASIAK 2018, p.439-444) (SATORA, SZKODA 2019, p.86-p89).

3. Methodological assumptions of the research

3.1 Goals and hypothesis

The main purpose of the work was to indicate the type of goods that are perceived as the most difficult to transport on the Polish and foreign markets. An additional objectives were going to indicate:

- whether the perception of the transport of goods with low transport susceptibility on the Polish market differs significantly from the perception on the foreign market;
- how companies perceive the difficulty of transporting goods with low transport susceptibility;
- difference between Polish and foreign market when it comes to transport of goods with low transport susceptibility;
- what type of cargo is perceived as most difficult to transport.

Research hypothesis was formulated as follows: **Polish companies have more difficulty transporting goods with low transport sustainability.**
The survey covered companies dealing with logistics on Polish and foreign markets.

3.2. Characteristics of the research sample

From the period of time: December 2021 to January 2022, a questionnaire survey was conducted via the Internet. The electronic form of the survey was sent to companies operating in the logistics industry. The link to the survey was sent directly to the company's e-mail account. I used pages with databases to find companies, which perform logistic activities[2].

[2] List of databases:
https://www.rynkometr.pl/pkd/49.41.Z
https://aleo.com/pl/firmy/logistyka-spedycja-transport
https://www.goodfirms.co/supply-chain-logistics-companies/poland
https://www.goodfirms.co/supply-chain-logistics-companies/germany
https://www.logisticsfrance.com/Logistics_France
https://www.goodfirms.co/supply-chain-logistics-companies/france
https://clutch.co/br/logistics/supply-chain-management

This made it possible to efficiently find many companies, often with e-mail addresses. If there were no such addresses on the website, I searched for them manually.

In Appendix 1 there is a list of companies to which I sent a message. The research process required time and a great deal of dedication on the part of the researcher because often, several e-mails were sent to one company due to several correspondence addresses and a large number of branches of the same company. Also, the messages themselves were re-sent several times. In total, e-mail was sent to 580 companies all over the world. Exactly 40 companies underwent the study, 15 of them located in Poland and 25 outside of Poland.

The percentage of correctly completed surveys was 6,9%. The hole process was time and labor intensive due to the factors mentioned above.

Considering the size of enterprises according to the number of employees: 9 companies (23%) where the number of employees did not exceed 25 people, 6 companies (15%) where the number of employees was in the range of 25-50 people, 10 companies (25%) where the number of employees there were between 50-250 and 15 companies (38%) in which the number of employees exceeded 250 people. The size of the companies is shown in the chart 2.

https://cargo-cards.com/en/directory/croatia/logistics-companies/
https://clutch.co/es/logistics/supply-chain-management
https://www.goodfirms.co/supply-chain-logistics-companies/uk
https://www.goodfirms.co/supply-chain-logistics-companies/china
https://www.goodfirms.co/supply-chain-logistics-companies/japan
https://www.logisticshungary.com/Logistics_Hungary
https://clutch.co/mx/logistics/supply-chain-management
https://clutch.co/ar/logistics/supply-chain-management
https://www.goodfirms.co/supply-chain-logistics-companies/south-africa

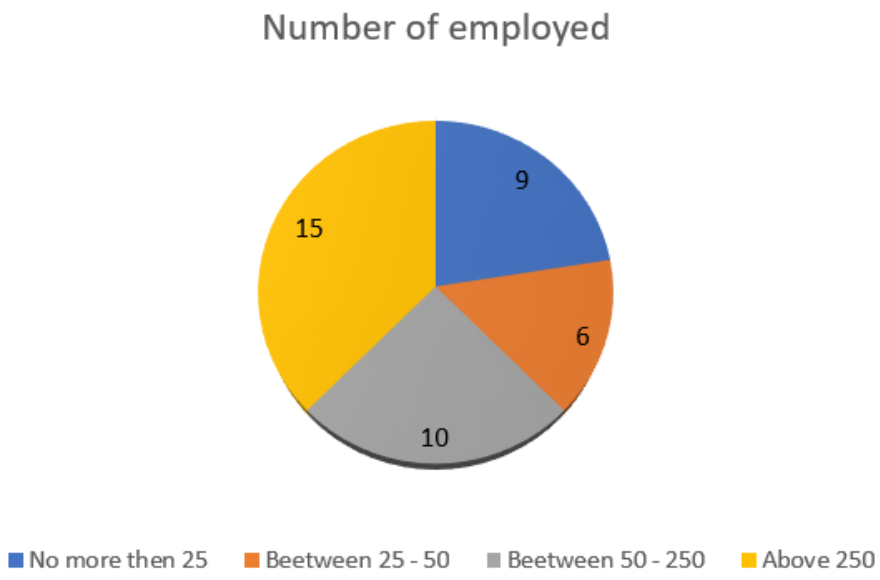


Chart 2. Number of employees in the surveyed companies in Poland and abroad.

Source: own study based on research

In a survey on the Polish market, I received 15 responses, where 2 companies (13%) employed less than 25 employees, 5 companies (33%) employed between 25 and 50 employees, 3 companies (20%) employed between 50 and 250 employees, over 250 employees were employed by 5 companies (33%). The size of the companies is shown in the chart below.

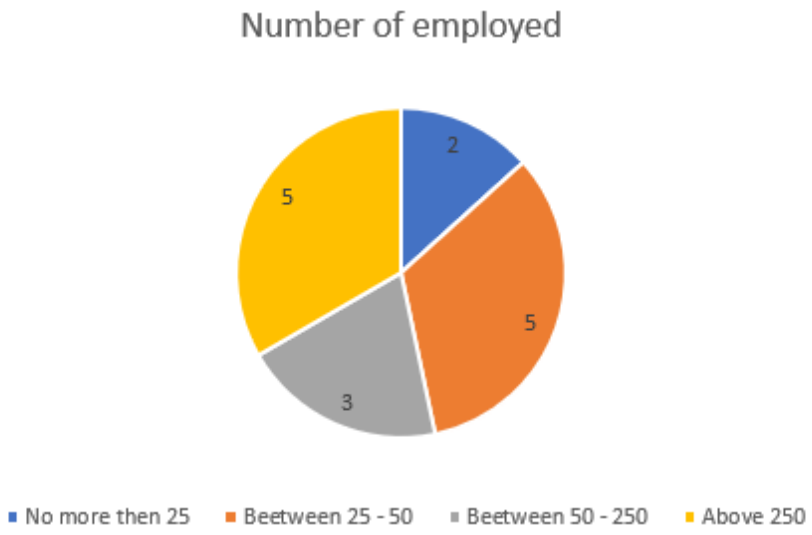


Chart 3. Number of employees in the surveyed companies in Poland.

Source: own study based on research

In the study on the foreign market, I received 25 responses, where 7 companies (28%) employed less than 25 employees, 1 company (4%) employed between 25 and 50 employees, 7 companies (28%) employed between 50 and 250 employees, over 250 employees were employed by 10 companies (40%). The size of the companies is shown in the chart below.

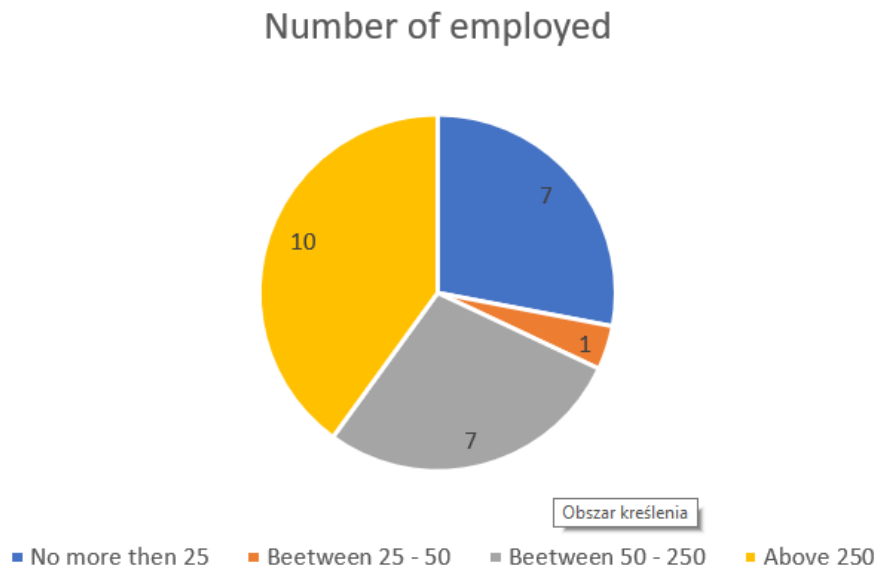


Chart 4. Number of employees in the surveyed companies abroad.

Source: own study based on research

3.3. Method of the research

The study was conducted using an anonymous questionnaire survey via the Internet, by sending questionnaires directly to companies on the Polish and foreign market.

A seven-point Likert scale was used in the survey. It measures the respondent's rating in a bipolar manner, and the points on the scale are evenly spaced.

The respondents were asked to answer the following questions:

1. Does your company transport loads with low transport susceptibility? (difficult to transport, e.g. oversized loads) (yes – no)
2. Has the company rejected the cargo proposal due to the difficulty of transportation? (yes – no)
3. How, in your opinion, is your company prepared to transport sensitive goods? (1-7 – where 1 – very poorly; 7- very good)

4. Sensitive to transport time (e.g. food products) (1-7 – where 1 – very easy; 7 - very hard)
5. Sensitive to damage (e.g. porcelain) (1-7 – where 1 – very easy; 7 -very hard)
6. Sensitive to moisture, temperature and light (e.g. paints) (1-7 – where 1 – very easy; 7 -very hard)
7. Harmful to human health (1-7 – where 1 – very easy; 7 -very hard)
8. Susceptibility to the absorption of foreign odors (1-7 – where 1 – very easy; 7 - very hard)
9. Irregularly shaped or large sized loads (1-7 – where 1 – very easy; 7 -very hard)
10. Goods that can damage or destroy other transported items (1-7 – where 1 – very easy; 7 -very hard)
11. How many employees does your company have? (less than 10; less than 25; less than 50; less than 250; more than 250).

4. Results of empirical study

4. 1. Difficulty of transporting goods with low transport susceptibility

The main purpose of the work was to indicate the type of goods that are perceived as the most difficult to transport on the Polish and foreign markets. An additional objective was to indicate whether the perception of the transport of goods with low transport susceptibility on the Polish market differs significantly from the perception on the foreign market.

The vast majority of companies answered the question in the affirmative. On a question: does your company transport loads with low transport susceptibility, 11 Polish companies (73%) answered yes to this question and only 4 (27%) gave a negative answer. Companies on the foreign market also provided mostly positive responses. 23 companies (92%) answered positively and only 2 (8%) negatively. The sum of both markets gave 33 (87%) affirmative and 7 (13%) negative responses.

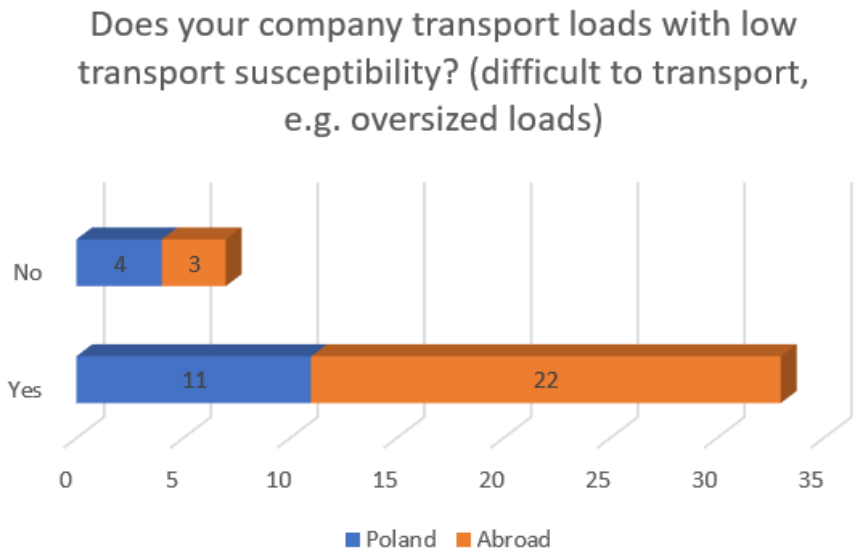


Chart 5. Number of companies transporting loads with low transport susceptibility.

Source: own study based on research

The vast majority of respondents on the Polish market rejected the transport order due to the difficulty / costs, 14 out of 15 companies (93%) and only 1 (7%) never rejected the transport order. The results from the foreign market show a similar situation. 24 out of 25 companies (96%) rejected an order, and only in one company (4%) such a situation did

not occur. The sum of respondents in both markets gave 38 companies (95%) that rejected the order and 2 (5%) that never did. The results in both areas of the study are therefore very similar. The results are shown in Chart 6.

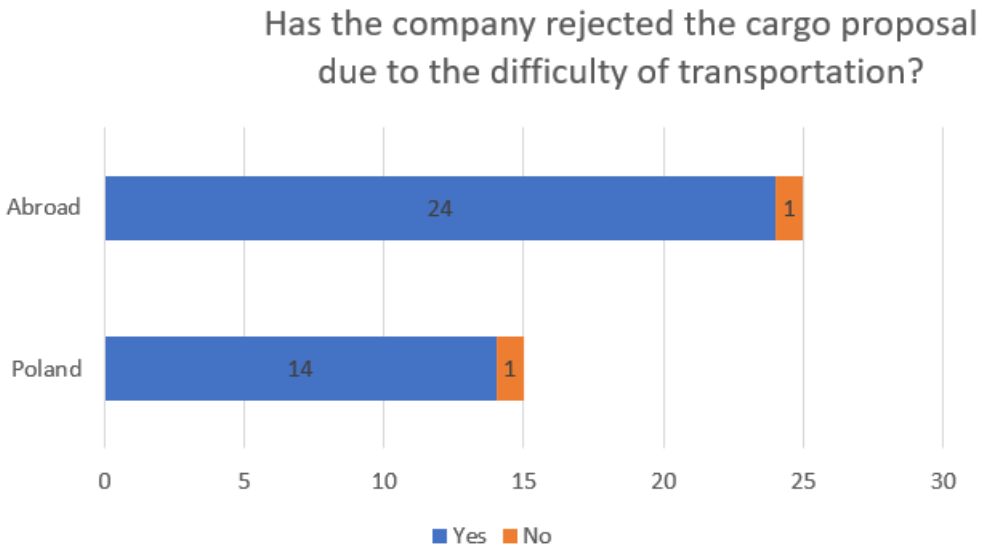


Chart 6. Number of companies that rejected a cargo proposal due to the difficulty of transportation.

Source: own study based on research

4.2. Preparation of companies to transport of sensitive goods

Most companies are poorly prepared for the transport of sensitive goods. Overall, the most frequently reported response was that of 2 and the mean score was 3.125. Abroad, the answer was 4, and the average score was 3.36. Polish companies most often answered 3 and the average in their case was 2.7 (3). So it can be concluded that they are less prepared for transport. All values are described in the chart below.

Chart 7. Preparation of companies to transport sensitive goods.

Source: own study based on research

The average value of opinions for both areas about the difficulty of transporting goods susceptible to transport time was 4.075 and the most common value was 3. In Poland, the average value was 4 and the dominant was 3, while abroad the average was 4.04 and the dominant was 5. Here observe a worse assessment of companies located in Poland. All values are described in the chart below.

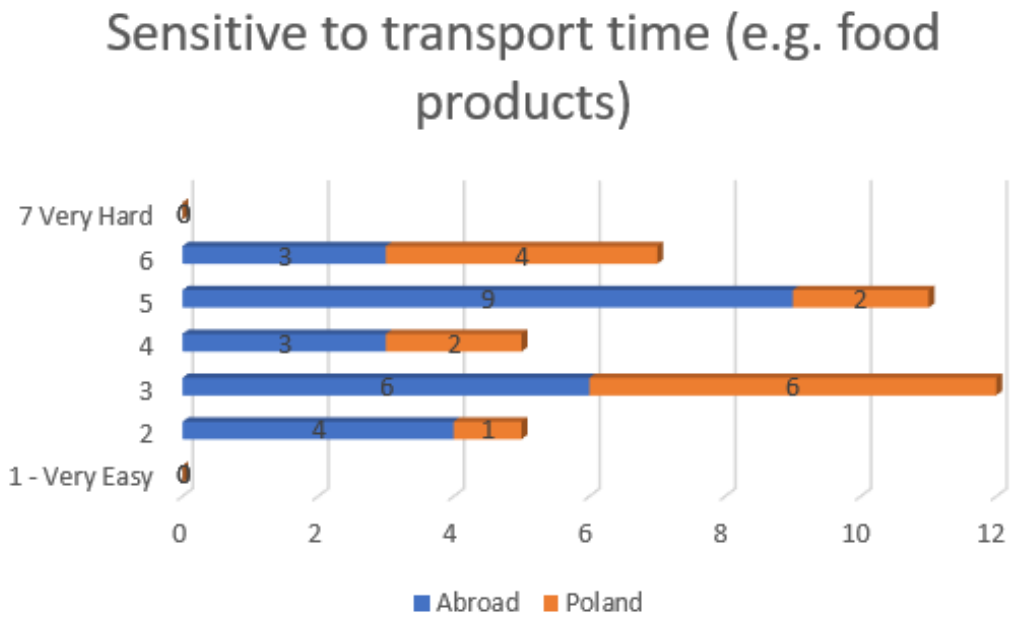


Chart 8. Preparation of companies to transport goods sensitive to transport time.

Source: own study based on research

The average value of opinions for both areas about the difficulty of transporting goods sensitive to damage was 4.125, and the most common value was 4. In Poland, the average value was 3.87 and the dominant is 4, while with the border the average is 4.28 and the dominant is 4. Here, we can again observe a greater value of assessments in regions outside of Poland. All values are described in the chart 9.

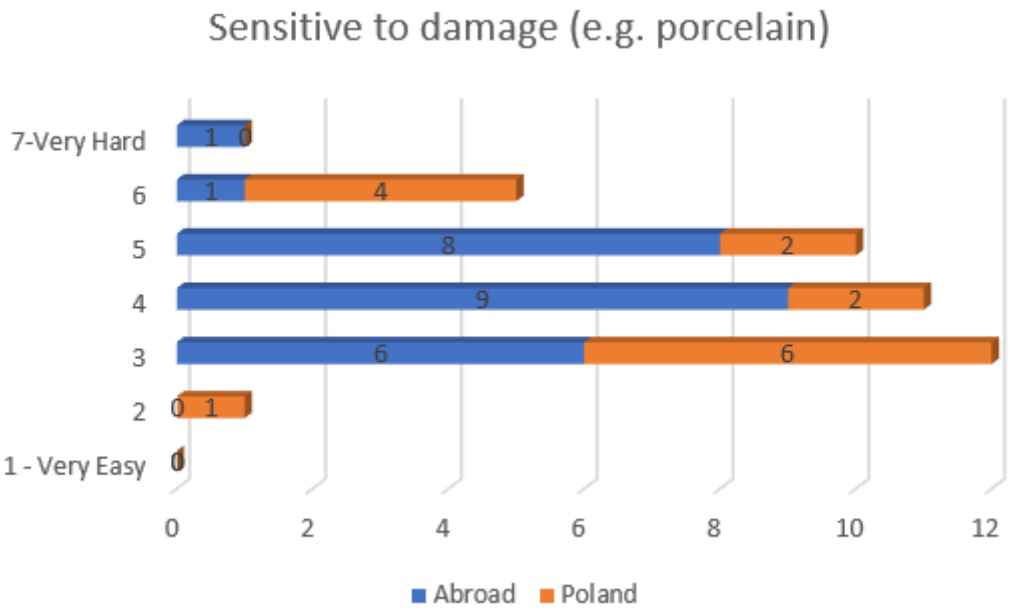


Chart 9. Preparation of companies to transport goods sensitive to damage.

Source: own study based on research

The average value of opinions for both areas about the difficulty of transporting goods susceptible to moisture, temperature and light was 3.95 and the most common value was 4. In Poland, the average value was 3.7 (3) and the dominant was 4, while abroad the average was 4,04 a dominant 4. We can observe here a slightly higher rating in regions outside of Poland. All values are described in the chart 10.

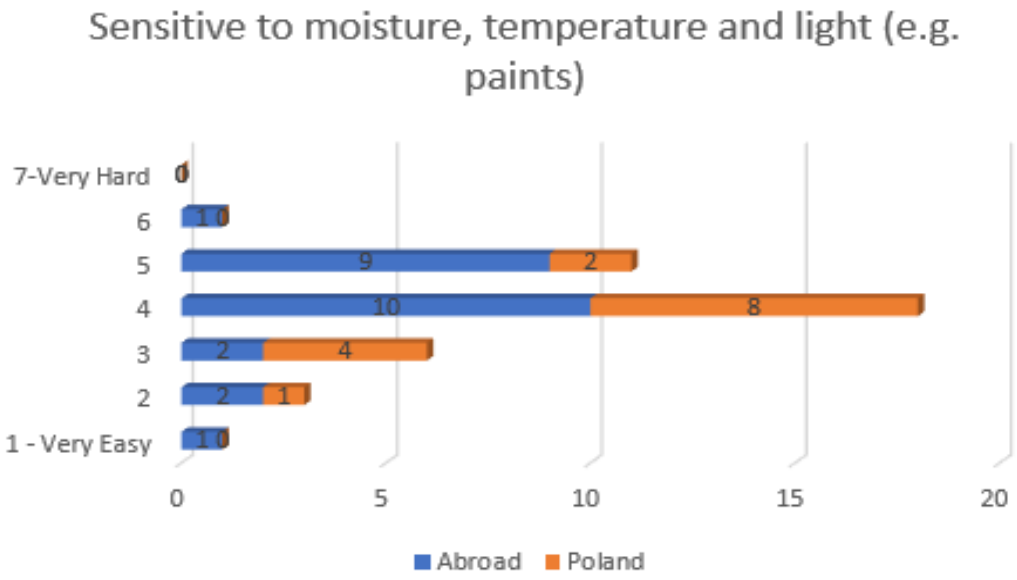


Chart 10. Preparation of companies to transport goods sensitive to moisture and light.

Source: own study based on research

The average value of opinions for both areas about the difficulty of transporting goods harmful to human health was 5.37 and the most common value was 6. In Poland, the average value was 5.5 (3) and the dominant was 6, while abroad the average was 5,28 and dominant 6. We can observe here a much higher grade in regions outside of Poland. All values are described in the chart below.

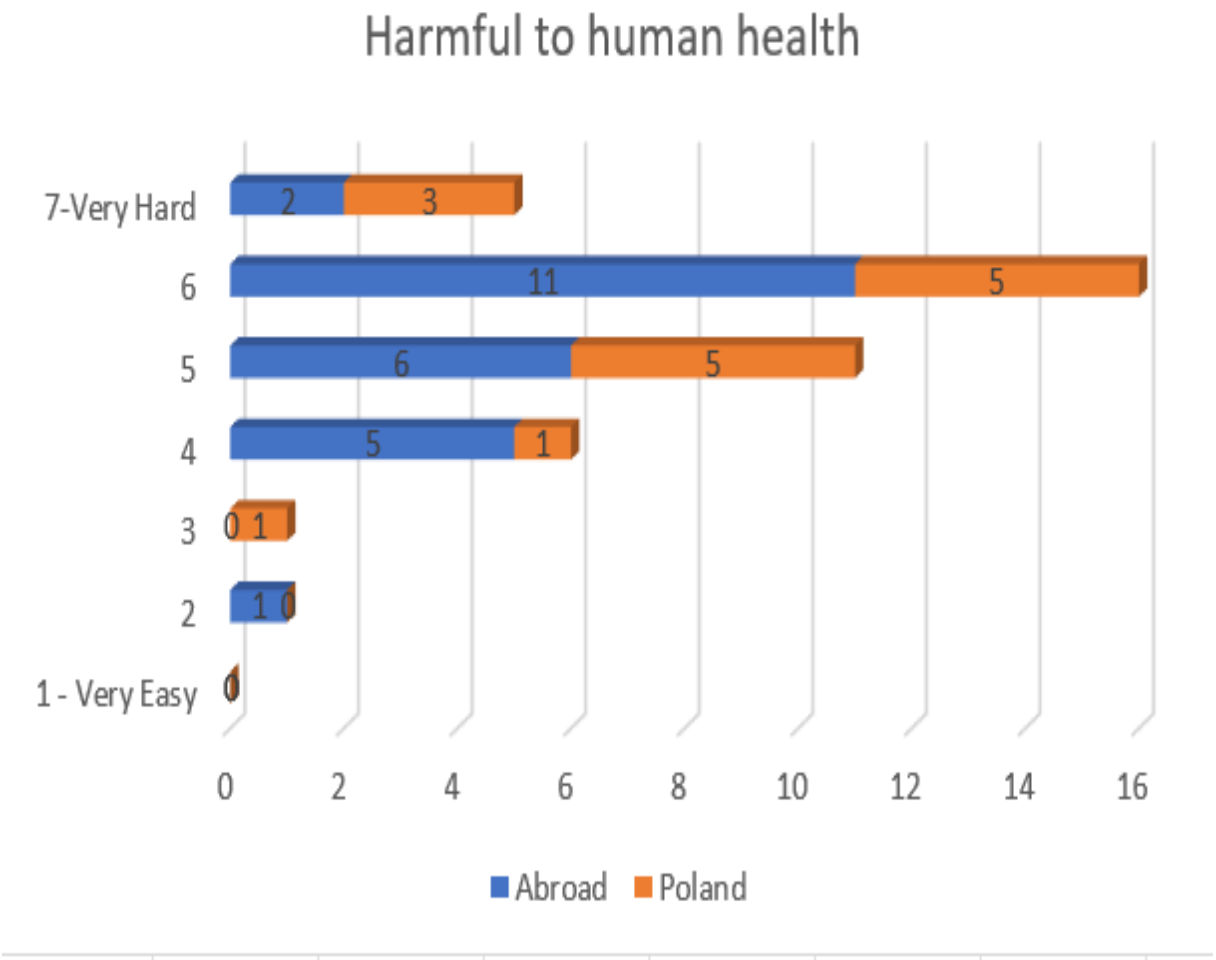


Chart 11. Preparation of companies to transport goods harmful to human health.

Source: own study based on research

The average value of the sum of opinions for Poland and abroad about the difficulty of transporting goods susceptible to the absorption of foreign odors was 3.9 and the most common value was 4. In Poland, the average value was 3.666666677 and the dominant was 4, while abroad the average was 4, 04 a dominant 3. We can observe here a slightly higher rating in regions outside of Poland. All values are described in the chart below.

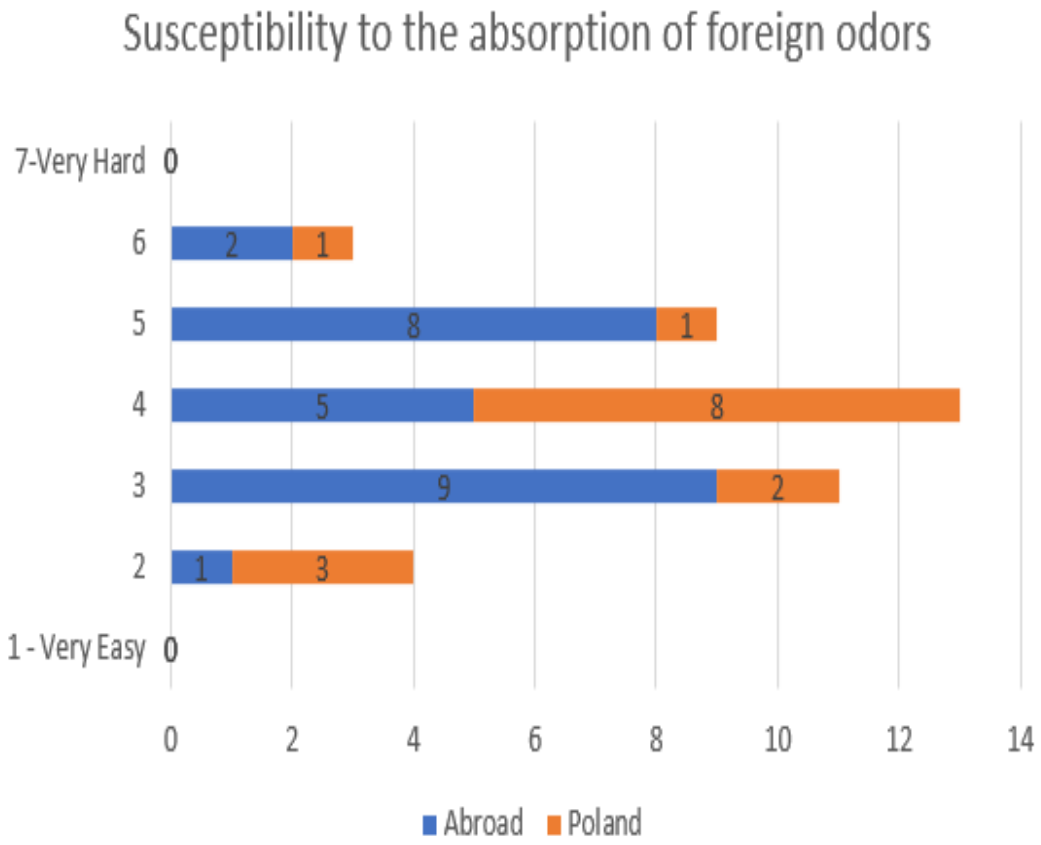


Chart 12. Preparation of companies to transport goods susceptible to the absorption of foreign odors.

Source: own research

The average value of opinions for both areas about the difficulty of transporting goods irregularly shaped or large sized was 3.775 and the most common value was 3. In Poland, the average value was 3.8 and the dominant was 3, while abroad the average was 3.76 and the dominant was 4. Very slight differences in both regions were observed here. All values are described in the chart below.

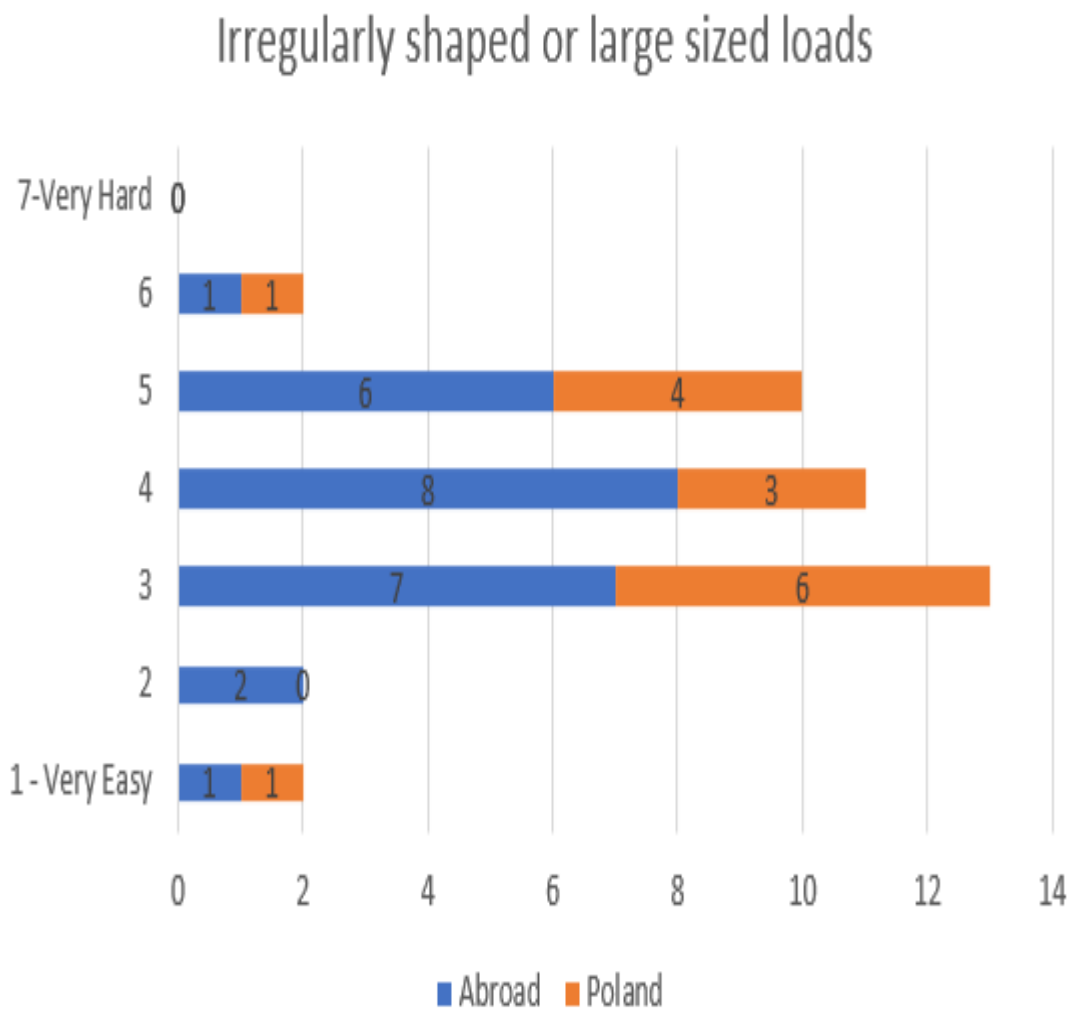


Chart 13. Preparation of companies to transport goods irregularly shaped or of a large size.

Source: own research

The average value of the sum of opinions for Poland and abroad about the difficulty of transporting goods that can damage or destroy other transported items was 3.15 and the most frequent value was 3. In Poland, the average value was 2.9 (3) and the dominant was 3, while abroad the average was 3 , 28 and the dominant 3. Again, there is a tendency to assess difficulties in countries outside Poland higher. All values are described in the chart below.

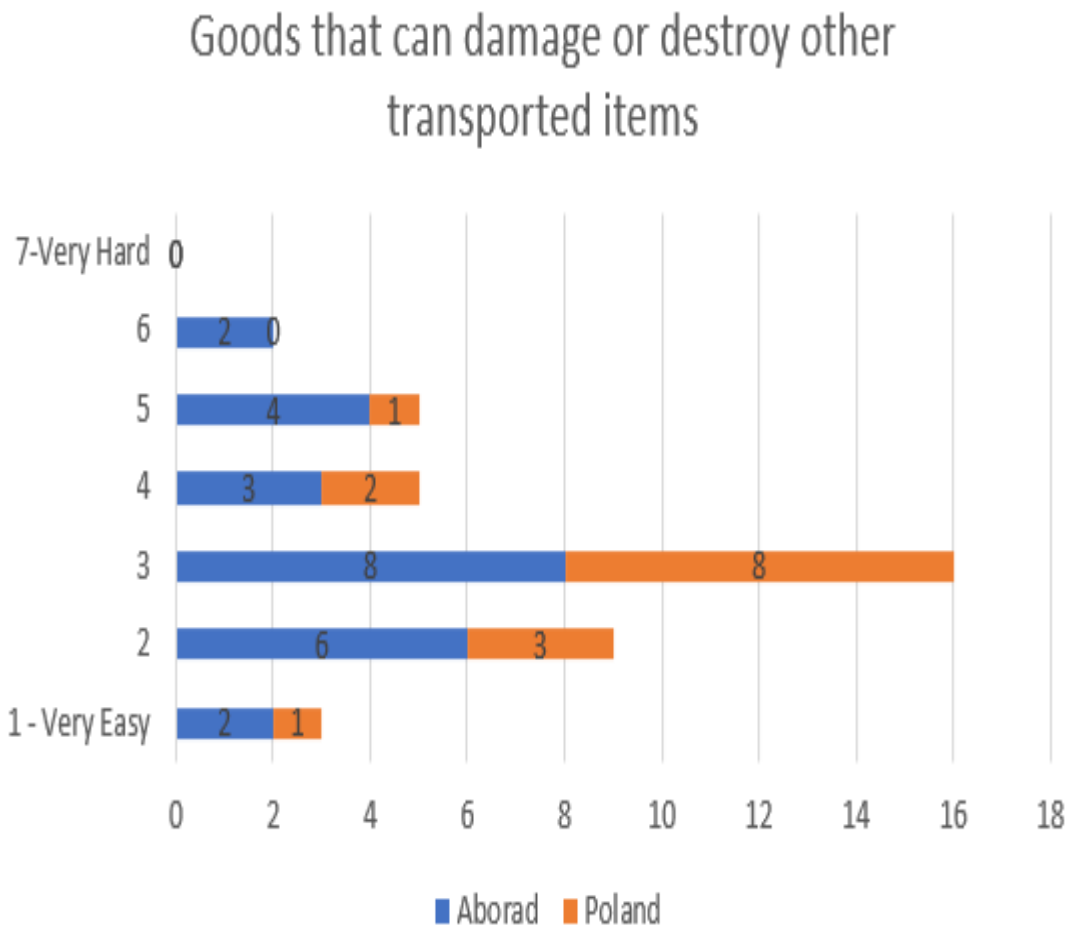


Chart 14. Preparation of companies to transport goods that can damage or destroy other transported items.

Source: own research

4.3. The correlation between variables

In the further part of the work, I examined the relationship between the answers to the questions. The most interesting indicators for me were those describing the relationship between the size of the company, the rejection of cargo due to the difficulty of transport, and whether the company transports loads with low transport susceptibility and the perception of difficulties in transporting goods with specific properties. I will also mention the highest and the lowest values. The following picture presents a summary of the Spearman correlation. Areas with a negative correlation coefficient are marked in red, the green value shows the point with the highest correlation coefficient and the yellow value with the highest negative r Spearman coefficient ($p<0,05$).

1		-0,10566	0,590301	-0,22135	-0,07368	0,106072	-0,37753	0,138723	-0,03227	-0,15454	0,416714
2	-0,10566		-0,05995	0,27164	0,256891	-0,01121	-0,02581	-0,02103	0,15166	-0,06393	-0,04403
3	0,590301	-0,05995		-0,41091	-0,21892	-0,02979	-0,13916	0,151713	-0,29534	-0,20459	0,388218
4	-0,22135	0,27164	-0,41091		0,123934	0,039481	0,048634	-0,21881	0,283359	0,187797	-0,38997
5	-0,07368	0,256891	-0,21892	0,123934		0,27352	-0,24357	0,034216	-0,14593	-0,03467	0,023879
6	0,106072	-0,01121	-0,02979	0,039481	0,27352		-0,1594	0,398575	0,198982	0,200316	-0,17606
7	-0,37753	-0,02581	-0,13916	0,048634	-0,24357	-0,1594		-0,21659	-0,03119	-0,23738	-0,06958
8	0,138723	-0,02103	0,151713	-0,21881	0,034216	0,398575	-0,21659		0,314731	0,156921	-0,07624
9	-0,03227	0,15166	-0,29534	0,283359	-0,14593	0,198982	-0,03119	0,314731		0,481344	-0,25512
10	-0,15454	-0,06393	-0,20459	0,187797	-0,03467	0,200316	-0,23738	0,156921	0,481344		-0,23176
11	0,416714	-0,04403	0,388218	-0,38997	0,023879	-0,17606	-0,06958	-0,07624	-0,25512	-0,23176	
	1	2	3	4	5	6	7	8	9	10	11

Picture 4. Correlation table.

Source: own research

1. Does your company transport loads with low transport susceptibility? (difficult to transport, e.g. oversized loads)
2. Has the company rejected the cargo proposal due to the difficulty of transportation?
3. How, in your opinion, is your company prepared to transport sensitive goods?
4. Sensitive to transport time (e.g. food products)

5. Sensitive to damage (e.g. porcelain)
6. Sensitive to moisture, temperature and light (e.g. paints)
7. Harmful to human health
8. Susceptibility to the absorption of foreign odors
9. Irregularly shaped or large sized loads
10. Goods that can damage or destroy other transported items
11. How many employees does your company have?

We can observe a negative weak correlation coefficient (R= -0.11; p=0.50), between companies transporting goods with low transport susceptibility and the rejection of the transport proposal due to the difficulty of transport, such a low value shows that even if the companies operate in the field of transport of goods with low transport susceptibility, reject shipping offers. However, high dependence occurs with the opinion about the preparation of the company for the transport of goods with low transport susceptibility (R= 0.59; p <0.01). This indicates that the companies that transport these goods are well prepared for their transport. There is a slight correlation in relation to goods sensitive to damage (R= -0.07; p=0.67) and goods of irregular shape (R= -0.03; p=0.84). Weak correlation in the case of goods sensitive to transport time (R= -0.22; p=0.73), sensitive to temperature, moisture and light (R=0.11; P=0.50), susceptible to the absorption of foreign odors (R=0.14; p=0.39) and goods that may damage or destroy other transported items . Average and at the same time the highest in this category is characterized by the opinion about the difficulty of transporting goods harmful to human health (R=-0.38; p=0.07), which gives us the view that companies that do not transport goods with low transport susceptibility evaluate precisely goods harmful to human health to be the most difficult to transport. The average relationship (R=0.42; p=0.01) occurs in relation to the size of the company. Therefore, the conclusion is that the size of the company, to some extent, translates into whether the company transports goods with low transport susceptibility.

When rejecting a transport order, there is little correlation with the assessment of the company's preparedness for transport with low transport susceptibility. (R= -0.06; p=0.71). There is also a slight dependence in the assessment of goods in the following categories: sensitive to moisture, temperature and light (R= -0.01; p=0.95), harmful to human health (-0.03) and susceptibility to the absorption of foreign odors (R= -0.02; p=0.9) and goods that can damage or destroy other transported items (R= -0.06; p=0.71). Weak correlation occurred in irregularly shaped or large sized loads (R=0.15; p=0.36), sensitive to damage

(R=0.26; p=0.1) and sensitive to transport time (R=0.27; p=0.09). The amount of employment in the company also has a low correlation value (R= -0.04; p=0.81), so it can be concluded that the size of the company has practically no influence on the rejection of orders for goods with low transport susceptibility.

When it comes to the perception of the difficulty of transport, taking the number of employees as the criterion, we can observe a slight correlation in the case of goods sensitive to damage (R=0.02; p=0.9), Harmful to human health (R= -0.07; p=0.67), susceptibility to the absorption of foreign odors (R= -0,08; p=0.62). Weak correlation occurred for goods sensitive to moisture, temperature and light (R= -0.18; p=0.27), goods that can damage or destroy other transported items (R= -0.23; p=0.15) and irregularly shaped or large sized loads (R= -0.25; p=0.12). The goods sensitive to transport time had the highest correlation index (R= -0.39; p=0.1). This may be due to the fact that the transport of food is usually carried out by specialized companies.

The correlation to the question of how well the company is prepared to transport sensitive goods was as follows. The average negative correlation (R= -0.41; p=0.01) occurred in comparison with the answers to the question about goods sensitive to transport time. Weak correlation occurred in the case of goods sensitive to damage (R= -0.22; p=0.17), harmful to human health (R= -0.14; p=0.39), Susceptible to the absorption of foreign odors (R=0.15; p=0.36), Irregularly shaped or large sized loads (R= -0,29; p=0.07) and Goods that can damage or destroy other transported items (R= -0.20; p=0.21). The only value of the slight correlation was the category of goods sensitive to moisture, temperature and light (R= -0.03; p=0.85)

For Sensitive to transport time goods, a slight correlation occurs for Sensitive to moisture, temperature and light (R=0.04; p=0.81) and Harmful to human health (R=0.05; p=0.76). In turn, it is weak for Sensitive to damage (R=0.12; p=0.46), Susceptibility to the absorption of foreign odors (R= -0.22; p=0.17), Goods that can damage or destroy other transported items (R=0.19; p=0.24) and Irregularly shaped or large sized loads (R=0.23; p=0,15).

Sensitive to damage goods had a low correlation coefficient in relation to the category Irregularly shaped or large sized loads (R= -0.14; p=0.39), goods that can damage or destroy other transported items (R= -0.03; p=0.85) and goods susceptible to the absorption of foreign

odors (R= -0.03; p=0.85). Weak correlation occurred in comparison with items harmful to human health (R= -0.24; p=0.14) and sensitive to moisture, temperature and light (0.27).

Goods harmful to human health (R= -0.16; p=0.32), irregularly shaped or large sized (0.19) and goods that may damage or destroy other loads (R=0.20; p=0.21) have a weak correlation with goods sensitive to moisture, temperature and light (R=0.20; p=0.21). There was also an average correlation here with goods susceptible to odor absorption (R=0.39; p=0.01).

Goods harmful to human health showed a poor correlation when compared to susceptible to the absorption of foreign odors (R= -0.21; p=0.19) and goods that can damage or destroy other transported items (Goods that can damage or destroy other transported items). Irregularly shaped or large sized goods had a low correlation coefficient here (R= -0.03; p=0.85).

The recently compiled categories Irregularly shaped or large sized loads and goods that can damage or destroy other transported items reached a factor of (R=0.48; p=0.01). We can indicate a certain relationship here, usually goods with irregular or large shapes can contribute to the damage and, naturally, both of these assessments will be related.

5. Conclusions

Companies on the Polish market rate the difficulty of transporting goods slightly higher compared to companies on the foreign market. As it was assumed, companies dealing with the transport of goods with low transport susceptibility believe that they are better prepared for their transport. The sheer size of the company does not translate significantly into the perception of the difficulties of transport. It is worth noting that among the companies that do not transport goods with low transport susceptibility, it is the goods that are harmful to human health that were considered the most difficult to transport. A high negative correlation of the value (-0.41) should also be indicated, it describes the relationship between the perception of the company's preparation for transport and the assessment of the difficulty of transporting goods sensitive to transport time. It can therefore be said that the better prepared a company is to transport goods with low transport susceptibility, the easier it is to transport perishable goods. The vast majority of companies rejected the transport offers. The companies evaluate their preparation for the transport of goods with low transport susceptibility significantly low. This may be due to the fact that a large number of companies do not transport such goods on a daily basis or specialize in the transport of one type of goods, e.g. food. All types of goods had relatively high difficulty ratings.

The main goal of indicating the type of goods perceived as the most difficult to transport on Polish and foreign markets has been achieved. The highest values were observed in the following factors:

- harmful to human health - 5.37;
- sensitive to damage - 4.125;
- sensitive to transport time - 4.075.

Additional goals were aimed to answer the following problems and questions and they were achieved in the thesis:

1. *Does the perception of the transport of goods with low transport susceptibility on the Polish market differs significantly from the perception on the foreign market?* Research indicated that Polish companies have more problems transporting goods with low transport susceptibility. The average opinion on the preparation for transport of goods with low transport susceptibility was 0.425 points lower in Polish companies. It indicated noticeable difference.

2. *How companies perceive the difficulty of transporting goods with low transport susceptibility?* Companies overall perceive transport of those goods as above average in difficulty. The average difficulty rating for all categories of goods was 3,90375.
3. *Difference between Polish and foreign market when it comes to transport of goods with low transport susceptibility*. It was proved in the research that Polish companies, despite evaluating their preparation worse than foreign companies in the survey, rated overall difficulty of transporting goods lower.
4. *What type of cargo is perceived as most difficult to transport?* Cargo perceived as most difficult to transport was the one that could potentially cause harm to human health. Average combined score on Polish and foreign market was 5.37.

Research has shown that the perception of difficulties in transporting goods with low transport susceptibility in Poland is higher than abroad. However, the study also showed a correlation saying that the better prepared a company is to transport these goods, the higher it assesses the difficulty of transport. In this case, it can be argued that they are not worse prepared, but have a greater idea of how difficult it is to transport them. Nevertheless, the assessment of preparation for the transport of goods with low transportability in their case was lower. Goods harmful to human health were ranked highest on the difficulty scale. Polish companies judged themselves worse prepared than those on foreign market, this could indicate that in theirs opinion they have less tools to move cargo in question. Despite lower self-evaluation they assess difficulty of majority of all types of goods lower. This could also confirm thesis that the more knowledge and preparation a company has, the more difficulties it notices.

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Dziennik Ustaw - *ZAŁĄCZNIK „B" PRZEPISY DOTYCZĄCE ŚRODKÓW TRANSPORTU I OPERACJI TRANSPORTOWYCH*

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Appendix:

Appendix 1.

List of surveyed companies

OLIMP TRUCK	Firma Handlowo-Usługowa Robert Jankowiak	ALT EXPRESS
WOL-TRANS	BTZ LOGISTICS	SIMON – LOGISTICS
SPEED TRANS	JERRY TRANS	Real Logistics
Marko Service	Polish Forwarding Company	Jastim
IKA Logistic	NATANEX	Kaspeda
Optima Logistics Group	DTS Transport	Diera
PKP CARGO	LINK	Leader Logistics
Logisys	FREJA Transport & Logistics	DTA
Greengage	Priority Freight	DOT CARGO
ENPIRE	Air Express Poland	ROHLIG SUUS
MOL Logistics Poland	ROBERT MULLER	Interfracht

Fastair Cargo	AMG Cargo Logistics	Omida
GFS Polska	Symlog	Dropex
Internel Sp. z o.o.		star/trac
INVERTO	asap logistics	ACS
Heppner	AB	BLG LOGISTICS GROUP
hartrodt	SHIP-LOG	MSC
Quyntess	Leschaco	WemoveBW
Kopf & Lübben	Siemens Logistics	Conceptum Logistics
Röhlig Logistics	Dls	Sea, Air, Transport & Service
Hamburg Süd	Borealis Maritime	Mundial RoRo Shipping Service
Hamburg Tankers	Agotrans Air Cargo	CSP Frankfurt
VISA Global Logistics Germany	Fiege Logistics	Honold Logistik Gruppe
Helm AG	QCS-Quick Cargo Service	Star Cargo Berlin
K SATS Group	F.W. Neukirch	FREIGHTFINDERS
alpha trans company	Detzer Aircargo Service	ITG
Emons	Linther Spedition	Yarres International Logistics
Rudolph Airtransfracht	Corporate Service	eCom Logistik
Lufapak Fulfilment	Good-Stock	MOODJA

Zenfulfillment	Vireoloxx	united cms
AMK Logistik	Codept	Wolanski
VAH Jager	acut fulfillment	Lentz Druck und Medien
Warehousing1	media impuls KG	EWANTO
Everstox	Biz	PVS Europe
WINST Umzüge & Transporte	Porath Customs Agents	EELS
Stravex	ROSFLOT	GTG
Customs Broker	Logivest	Candidus
mula	TBN	Waredock
niologic GmbH	Schneider Transport	Bansard International
Flytrans	Gefco	Getma
Henry Johnson	Isys	LDI Dimotrans Group
Mathez	Saga	Pronto Cargo
Rodovitor Transport	Novatrade Brasil	Fox Brasil
Nippon Express	Yusen Logistics	Panalpina
Maxitrans	Cassotis Consulting	Leão de Judá
Norte Brasil Logistica	Imexlog Logistica Aduaneira	Shipfrombrazil
BRAELLI MULTI SERVIÇOS	Gluck Consulting	Serveporto Group

Super Terminals	Mecalux Warehouse Solutions	INTERCONTINENT
LAM SERVICES	Advancy	Primacošped
AGIT	Log Adria	Jadroagent d.d. Rijeka
Intereuropa logističke usluge	Croatiašped	Trast
Adriatic Logistics	Mecalux Warehouse Solutions	Logiflor SL
8L Consultoría Logística	Marcotran	Autransa SL
Cosco Shipping Lines	Estrada de Transportes, S.C.G	Grupo Perez y Cia. Panama
Lamaignere Cargo	Eurocruz	Logitransit
Alas Latinas	DAYJO Logistica	Grupo Moldtrans
Logisfashion	Across Logistics	COTRANSA
TRANSCOMA GLOBAL	Marola Export	eGlobe
Logística Urbetrans	Transdomitia	Coordinadora
BAS & JOSA	Junior Freight	Aduanas Llobet
Eurobooking Cargo	GLOBAL CARGO SYSTEM S.A	Disnet
Transtact Cargo Centro	P&J Trans European	AFS

Importacargo	e2e Logistics Solutions	Spainbox
FALCON CARGO LOGISTICS	PANCARGO FREIGHT SERVICES	Datisa Forwarders
Transmar Logística	Global Cargo	Transteus
Zaudera	CMA CGM	Agility
GAC UK	Wincanton	Eddie Stobart
Palletways	ROLL – International Forwarders	Freightliner
Mango Logistics Group	Clipper Logistics	Menzies Distribution
Turners (Soham)	Bibby Distribution	Meachers Global Logistics
Unsworth	The Supply Chain Consulting Group	John Good Logistics
Cirrus Logistics	Simarco	Intersped Logistics
OBS Logistics	Walker Logistics	Bezos.ai
Zendbox	Quotex Systems	ASM Freight Services
Chain Logistics Services	ETA LOGISTICS	GCS
Century Logistics	Best Food Logistics	Cardinal
McDonagh Supply Chain Consultants	Kiss Logistics	Graylaw Freight Group
WTA	Chess Logistics	3P Logistics
Freedom Logistics	Velta International	H & A Transport Group

Maritime Transport	Crane Worldwide Logistics	Brownridge Transport
Hellmann	Farsley Transport	Bosun Logistics
Leeds Parcel Company	Walkers Transport	Moran Logistics
Paul Trudgian	LTS Global Solutions	Mobile
Atlas Logistics	PGS Global Logistics	DRP Logistics
Metro Shipping	CEVA Logistics	Allport Cargo Services
MSC	XPO Logistics	Warrant Group
Far Logistics	EMS Logistics	Freight Logistics
M.A. Logistics	Mac Logistics	Dartsswift International
Carlton Freight	I.E.K. Logistics	Bryanston Logistics
Aero Cargo Logistics	Williams Shipping	Alloga
Atlantis Forwarding	B.K.L Freight Services	Carry Cargo International
Economy Freight Services	Tudor International Freight	FUSION FREIGHT
Puma Cargo UK	Stagefreight	Longs of Leeds
Bluebox Moving Company	Plantforce	Heritage International Freight
John Good Group	City Cargo Services	Cardinal Maritime
ITD Global	Ship4U	Nortons Hiab Services

Uniexpress	Lion Containers	Trans-Bridge Freight Services
Lysander Shipping	Shipping Services	NS Shipping
Jenkins Shipping	FWD Freight Services	Britannic Shipping Services
Publiship	Lombard Shipping & Forwarding	Britannia International
Teekay	Anglo Pacific	International Removals Companies
International Shipbrokers	Norbulk Shipping	DFS Worldwide
Lomar Shipping	Track Freight Services	Anglia Forwarding
Genesis Freight Services	FRIENDS GROUP	Airfreight Worldwide
Embassy Freight Services	City Quick Logistics	Global Freight Forwarders
AFRICARRY	Transglobal Express	DPD UK
Simba Freight	Neely Transport	Forward Trucking Services
VKVP Haulage	Welch's Transport	Dyce Carriers
Panic Transport	Hunt's Transport	World Freight Transport
1st Move International	OPEX Logistics	Denholm Global Logistics
R D Anderson Haulage	Monarch Transport	Waller Transport Services
Matrix Scotland	HH Distribution	Axis Transport
Currie Solutions	Shetland Transport	Freight Express

Norfolk Logistics	Galt Transport	Allways Freight Services
M&H Logistics	Shetland Transports	Meadows International Removals
McLanachan Transport	Carntyne Transport	KB Transport Solutions
Blue Whale Logistics	Metoni Logistics	AAA Logistics
Cobley Transport	Crouch Logistics	Trix Logistics
GTA Transport	Translink Express Logistics	Advanced Supply Chain Group
Torque	Aztek International Freight	McDowell
Gist	A.Leadbeater Transport	Freightlink Europe
PD Bannister Transport	Marcus Transport	Johnston Logistics UK
CDL London	SW Group Logistics	Fullers Logistics
3rd Party Logistics	Bray Solutions	Progressive 3PL
DK Fulfilment	Absolute Warehouse Services	UK Global Logistics
Onward Holdings	C M Downton	Gregory Distribution
Denholm UK Logistics	Parker International	Polaris
Interspan	Brunel European	AAI Group
Thorn 3PL Services	Parcel Warehouse	RGF Logistics
Kammac	Spatial Global	Andrews Shipping
Global Freight	GBS Freight	JS Forwarding

International Forwarding	Brunel Shipping	KL Freight
Shippo	EMS Cargo Ltd	YFT Logistics
TE Shipping	CONVENANT CARGO	London Freight Services
KJ cargo services	D & K Freight	Arab Cargo
Freightair	Onestopservices	Freight2Gambia
DG Freight	Corvus Air Cargo	Express Cargo UK
Marco Services	Bigsam Global Logistics	Cargolord
Bettafreight Services	Millennium Cargo	Zakli International
SPARKHILL FREIGHT & TRAVEL	OPEN Cargo Services	London Cargo Freight
Immediate Transportation	Zigofly.com	Cargo Xpress & Fulfillment Services
Green Fulfilment	FulfilPro	Adstral Fulfilment
CSM Logistics	INTERPROFIS	Rapid Fulfillment Services
myWarehouse	Whitehouse solution	BOXstation
FPS DISTRIBUTION	Diamond Logistics UK	Vision Logistics
Prolog Fulfilment	MCI Logistics	JDS Distribution & Logistics

PDQ Distribution	Cargocare	SAE Logistics
Fargo Line	GR Freight Services	Cobra Shipping
Evcargo Global forwarding	Clear Fr8 Limited	FMC Logistics
Octain Logistics	Simply Customs	RJJ Freight
Skyways Cargo	Good logistics group	PJ SHIPPING
Xpand logistics	Fast Courier Services	Lux Logistics
Messiah freight Ltd	Far East Shipping	Mainfreight
good chain and sustainable supplies	HYCX International Logistics	Apex Group
Everglory Logistics	Elee China Logistics	JIUYE Supply Chain Management Co.
Realogistics	Sinotrans	Kerry Logistics
Honstrans International	Worldcargo Logistics	E-commerce Logistics
CRSCL	Linde Beijing International Transport Agency	International transportation
ZhenHua Logistics	Shengyu Freight	Guangzhou Xiyang Logistics

SHENZHEN KAKO INTERNATIONAL FORWARDING	Guangzhou Trinity Marine International Freight Services	Debang Express
Zhongtong Express	Guangzhou Wanhang Logistics	Chengda Group
Sanity Freight International (China)	JJ Shipping	Shanghai Huidong Shipping
Yicheng Logistics	Wanhang International Logistics	Shanghai Hada International Freight Forwarding
Shenzhen Andasun International Logistics	SHENZHEN KINGSTAR SHIPPING	Millennium Logistics
Beijing HYCX	Jiayou International Logistics	UOF International
NNR Global Logistics	Isewan Terminal Service	MOL Logistics Global
SAGAWA	Transcontainer Limited	SENKO
Logistics Mates Corp	RGF	HAVI
Konoike Group	Sinotrans Japan	Kintetsu World Express
Kokusai Express	Nichirei Logistics	UCI Air Freight Japan
ALISPED JAPAN LTD	Japan Cargo	Suzuyo

Art Trading	KSA International	KOKUSAI EXPRESS JAPAN
Foppiani Shipping & Logistics	APL	JFC
Bollore Logistics Mexico	ModusLink	Grupo CICE
Cinlat Logistics	Servicargo	G-Global
Gamas	Simply Orange Mexico	Dietrich - Logistics
JD Group	MieryTeran	Ravisa
Transportes Condesa	Auto Tanques de México	Ibimex
Soma	ICS Packaging and Logistics	TIBA México
TASA Logística	TRF	ZARCAM
Cotia	OSH	SIF Group
DIEB	Galeón Logistics	All In
Value Logistics	Transnova Africa	Laser Group
Tsiko Africa	Road Freight Logistics	APG Logistics
MORGAN CARGO	Alpha Shipping	