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SAFETY OF TRANSPORTATION OF PALLET SHIPMENTS BY A SELECTED LOGISTICS OPERATOR

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Purpose: A key issue in the transportation of pallets is their proper preparation. The selection of an appropriate pallet, the stacking of goods and the proper securing of the pallet with the cargo is intended to minimize the risk of damage to the goods. Transporting goods on a pallet allows for additional protection of fragile items, as well as transporting heavy or oversized cargo. Unfortunately, damage to transport shipments is a common problem for many companies, for the sake of the damage to the goods being transported and the costs they entail. That's why it's so important to be safe when transporting pallet shipments to reduce its negative effects. This article addresses the problem of a logistics operator that serves its customers by first placing products on pallets and then loading the pallets onto trucks. In addition to the standard geometric constraints of keeping products from overlapping and exceeding the dimensions of pallets and trucks, there are many other constraints in this real-world problem, related to the total weight of the load or the distribution of the load inside the truck, as well as transportation safety. By analyzing the transportation process and shipment damage data, it was possible to propose measures to implement to reduce or eliminate the occurrence of damage to pallet shipments.

Design/methodology/approach: The article briefly reviews the literature in the area of the concept of pallet. A map of the processes of execution of the transport order of pallet shipments was used, as well as FMEA analysis, which is an effective tool for identifying potential risks, causes of damage and their impact on the process of transporting pallet shipments.

Findings: The purpose of the article was to analyze the current state of transportation management in the studied company using process mapping and to detect the causes of the appearance of damage to pallet shipments using FMEA analysis.

Originality/value: As the selection of an appropriate pallet, the stacking of goods and the proper securing of the pallet with the cargo is aimed at minimizing the risk of damage to the goods, the topic addressed is relevant to the business of the logistics operator under review.

Keywords: logistics provider, transport process, pallet, pallet shipment, security of shipment transportation.

Category of the paper: case study.

1. Introduction

Security of transportation of pallet shipments by the selected logistics operator is a key element of effective and efficient supply chain management (Kołdys, 2015; Silva, 2023). Companies are increasingly relying on logistics operators to focus on their core business activities, delegating the area of transportation to specialists[1]. Pallet transportation, on the other hand, is an indispensable part of modern logistics and supply chains (Bieniek, 2019; Quiter, 2023). It involves the use of pallets to efficiently and safely transport goods from one point to another, whether it's shipping products overseas or delivering orders at home. With the increasing demands of global trade, pallet shipping has become a key aspect for companies to ensure that their products reach customers in accordance with the 7W principle. Therefore, one of the most important areas is packaging. It is the packaging that determines whether the product will reach the customer in proper condition. Packaging that will provide the transportation company with the information needed to move the product to the correct customer location (Witos, 2021; Herzau 2021). Whether transporting a single commodity or a larger quantity of goods, it requires proper planning and a lot of steps to make sure that everything runs smoothly and without unnecessary complications, so that the transport is safe (Smolnik, 2018; Wasiak, 2016). Pallet shipments are an integral part of all transportation, and failure to use pallets could very negatively affect all logistics processes. The task of pallets is not only to facilitate transportation, but also to ensure the safety of both goods and the environment and people involved in the transportation process. Pallet shipping is a key logistics process for many companies. It is a safe and easy way to move cargo It can, however, also be complicated and require the organization of many activities to secure the goods. It is also worth noting that pallets are one of the most widely used returnable transportation items and are a key resource for the supply chain, as they have a significant environmental and economic impact throughout their life cycle (Masis, 2022). Unlike other packaging products, pallets are specifically designed to be reused. This, in turn, is good for the environment as it reduces waste. Pallets play a key role in handling and transporting products at all levels of the supply chain. Pallets are used to handle unit loads of raw materials that are shipped from suppliers to manufacturers; in turn, manufacturers ship finished products on pallets to distributors; and finally, distributors fill orders to retailers on pallets (Debjit, 2016). As the structural basis of unit load, pallets provide efficient and standardized material handling and logistics around the world. An estimated 80% of trade in the United States (US) is conducted on pallets (Carrano, 2018), and pallets are undoubtedly the most widely used unit load platform in the world (Kończak, 2023; Martin, 2021). Approximately 450-500 million new pallets are produced annually, joining the approximately 2 billion pallets in circulation in the US (Buehlmann, 2009). In the European Union, about 280 million pallets are in circulation each year (Debjit, 2016). In view of the specific relevance of the topic and its importance for the conduct of effective operations of

[1] Trends and perspectives for pallets and wooden packaging (2016) United Nations ECE/TIM/2016/6.

a logistics operator, the research question posed is: the application of FMEA analysis and obtaining information on the causes of disruption to the safety of pallet shipments will improve their safety and that of people who are in the vicinity of the shipments and the loading area.

2. Specificity of pallet shipment

The pallet is an indispensable item to discuss in order to move forward with your work, and the importance of the pallet and the role it plays has a significant impact at every stage of the movement of goods. The pallet is the basis for storing items, allowing them to be transported by forklifts without the need for reloading. Pallets are the basic loading platform that connects packaging with handling equipment, transportation means and storage equipment (Hassa, 2013). A pallet can also be defined as a package that can act as a bulk package, i.e. a direct packaging of units of goods, or a transport package, i.e. one whose purpose is to provide additional protection for materials and bulk packaging, during such maneuvers as transportation or storage. A pallet is a logistic unit that has a kind of dimensional system. At the moment, in the era of outsourcing, the pallet is also counted as a returnable packaging unit in the supply chain (Bendkowski, 2011). Their recycling is as possible given that they are made of wood, which is easily recycled (Szołtysek, 2009). Goods are placed on pallets for easy storage, warehousing, or transportation between different points. Such activities are among the basic logistics activities, so that the place, time and quantity of goods can be changed, all of which is greatly facilitated by the pallet (Bendkowski, 2013). It is an auxiliary device for storage and manipulation, as it is a platform for moving and storing inventory (Kij, 2019).

The following palettes are distinguished (Bril, 2012, Dudziński, 2002):

- Flat – these are devices with one or two plates, they can be reversible or irreversible, and the entrance to them can be on one or four sides. There are models with or without wings. Typically made of wood, metal, plastic, mixed materials. These types of pallets contain goods that are resistant to mechanical damage during transport and stacking.
- Post-type – reusable devices, they have posts that make it possible to stack pallet units without burdening the load placed on them. They are usually made of metal and their posts are made of wood.
- Box pallets – these pallets are suitable for repeated use, they are characterized by the fact that they have walls thanks to which it is possible to stack and store loads of unusual shapes. The walls protect the products inside against pressure when stacking them, as well as damage during transport.
- Specialized – these are devices whose shape and dimensions are prepared depending on the products stored with them, taking into account transport, storage and retrieval of materials from there. Pallets also allow goods to be stacked.

Pallet shipping is used when the weight of the package is greater than that specified for a standard or non-standard shipment without a pallet. A pallet makes it very easy to transport heavy and large goods. The most popular pallets are flat EUR pallets, whose features, physical properties and functionality are strictly defined. Their dimensions are precisely defined. The most commonly used pallets are 1200 mm x 800 mm x 144 mm. The EURO pallet has dimensions of 120 x 80 centimeters at the base, and its maximum height after placing the load is approximately 200 centimeters. It is usually used to send parcels over 50 kilograms, and the highest pallet weight is 700 or even 1000 kilograms. The pallet performs many tasks depending on the method and purpose for which it is used. We can distinguish such tasks as (Litewka, 2018; Coyle, 2002; Toruń, 2016):

- Fulfilling the function of packaging, which includes protection for the goods, facilitates storage, transport and other manipulation activities, contains basic information about the products, how to handle the cargo, and how they can be disposed of.
- A means of facilitating unloading, loading and transport of goods over long distances.
- The use of pallets forms units of specific dimensions that can be picked up by robots and other devices, facilitating the work of people.
- In the case of disposal and its final use, it can be used as compost (after grinding), bedding for pigs, or can be used as a packaging material.
- Material for making furniture, flower stands, tool chests and much more.

The large size of shipments makes them difficult to manipulate when loading or unloading onto means of transport. The same problem occurs when there are a large number of shipments. Pallet shipments are used to facilitate shipment handling operations. These are shipments that use pallets on which the goods to be sent are placed and sent as one parcel. This method is used especially when shipments weigh more than 30 kg. When their weight reaches such a limit, they must be susceptible to mechanical overloading, i.e. using mechanical reloading equipment, e.g. a forklift. A pallet shipment makes this task easier because it is a carrier that is easy to pick up by a forklift. The goods on it are safe, and manipulation activities will not damage the goods or pose a threat to the surroundings. The pallet shipment must be properly secured to prevent it from deforming during transport, storage or warehousing. For this purpose, special foil or plastic or metal strips are most often used. When such a shipment is to be unpacked, it should first be carefully unwrapped to make it easier to retrieve the goods later (Odlanicka, 2014). Pallet shipments, which are one of the most common ones, are pallets with food goods and they are particularly exposed to damage during numerous operations in various distribution centers where they are located along their route (Grabowska, 2020). Therefore, they must be packed extremely carefully to ensure that each transported item is safe at every stage of the pallet shipment route.

Safety is a key task that should be a priority during every job. This should also be the case with the transport of pallet shipments and all related activities. You should always act prudently and take care not only not to damage the goods, but also not to pose a threat to people participating in any maneuvers related to its transport. Ignoring safety rules and failing to follow

them may cause damage to human health and irreversible damage to transported shipments. In order to avoid or minimize the possibility of a threat occurring, legal provisions and generally established rules by companies must be followed (Wołczański, 2014). The literature on the subject provides the basic principles that should be followed when securing pallet shipments (Bomba, 2018):

- Suitable pallet goods.
- Proper arrangement of goods on the pallet - so that they do not move or slide.
- Arranging enough layers of goods so that none of them is crushed, remembering that the maximum height of the shipment should not exceed 180 cm.
- Remember to take into account the weight of the entire pallet shipment and its even distribution.
- Ensuring that the goods do not protrude beyond their dimensions.
- Protection with an appropriately selected tool: heat-shrinkable foil, tapes, cardboard or wooden tops, corner boxes.

Placing the bill of lading in a visible place on the shipment, because this is where all the information about the goods and how to handle them is located. Additionally, you can place stickers with information on how to handle the goods. They will visually show what to do, which in turn will better inform the pallet operator (https://opaksystem.pl/...).

Ensuring safety in the transport of pallet shipments is a basic element of organizing loading activities. Thanks to the appropriate formation of loads, it is possible to move goods efficiently and in an intact condition. Good security protects the transported goods against damage and negative impact of the goods on the environment (Grzelak, 2018).

A significant factor in the safety of transported pallet shipments is their proper packaging and correct shaping. Packaging must properly protect the product against unexpected damage and protect the surroundings from the harmful effects of the product. A properly formed shipment allows for the effective use of the means used during transport and movement throughout the entire logistics chain (Galińska, 2016).

3. Actions of the logistics operator to secure the transport of a pallet shipment

The security of pallet units at the analyzed enterprise is crucial to ensure the integrity and safety of goods during transportation, storage and handling. The entity under study, due to the numerous manipulations of shipments and their rapid movement by road, must use many different types of security features to ensure that the transported goods arrive without damage from the place of shipment to their final destination. There are many types of security features for pallet shipments used both at the loading terminal and on the transport vehicle. Among the safeguards used by the surveyed entity are:

- Lashing straps - used on means of transport to prevent shifting of pallet shipments. Lashings usually made of special strong canvas stabilize the shipment, but be sure to use them according to the instructions and fasten them at the right angle to be most efficient and not damage the goods.
- Locking beams - are used to prevent the shipment from moving. In particular, they are fixed after the last shipment is loaded, when the means of transport is not fully loaded. Such protection blocks shipments from moving and pushing against the door, so that when the door is opened, shipments do not fall out on their own and contribute to causing hazardous events.
- Blankets - are used most often during extreme temperatures, i.e. severe cold in winter and hot days in summer. Shipments are then covered with a special thermal blanket to prevent large temperature fluctuations and keep the temperature relatively constant for shipments. They are used during the transportation of products at which such temperatures could adversely affect them.
- Stretch film - a flexible and durable film that is wound onto a pallet unit to protect goods from dust, moisture and mechanical damage. It is flexible, allowing it to conform securely to the shape of the cargo.
- Clamping straps - are used to hold pallet units securely in place. They can be placed around the pallet to prevent the cargo from shifting during transport.
- Protective corners - made of plastic or foam, they are placed on the corners of pallet units to protect them from damage during handling. They also help stabilize the load.
- Heat-shrinkable pallets - are a type of packaging that, when placed on a pallet unit, is subjected to heat, causing it to shrink and fit the load perfectly. This protection is especially applicable to one-time shipments.
- Temperature control systems - for shipments that need to maintain a certain temperature, temperature control systems such as refrigerated or heat-insulated packaging are used.
- Seals - are applied to both shipments and vehicles, in which full truckload shipments are most often transported. They must have an appropriate number and be documented so that it is known that the shipment has arrived safely from its starting point to its destination.
- Markings - It is important to properly mark shipments for their contents, transport conditions and movement. If a shipment were not marked it could be improperly picked up and subject to damage. There are ADR shipments that are hazardous shipments and they must be transported in a special way for them in order not to pose a danger. Therefore, it is very important to have proper labeling before such events.

It should be noted, however, that not every security is in the interest of the entity under study, as it only provides transportation services and that is the focus. On the other hand, such safeguards as, for example, packaging or securing a pallet unit in the first place is up to the shipper. The carrier has the right not to accept a shipment if it is poorly packed and secured. Then the shipper of such a shipment must properly secure it. All the safeguards used

significantly protect not only the goods, but also the environment from danger, injury, damage or financial loss. However, this is not always enough and, despite everything, damage does happen, which is something to pay attention to and then try to prevent.

The analysis of the transport process of the studied logistics operator and the analysis of data on the number of pallet units transported each day over a period of 6 months and the number of damaged shipments also occurring on each day of the month contributed to proposing measures whose implementation will reduce or eliminate the risk of damage to pallet shipments. The analysis of the transportation process was performed using a process map. This map is shown in Figure 1.

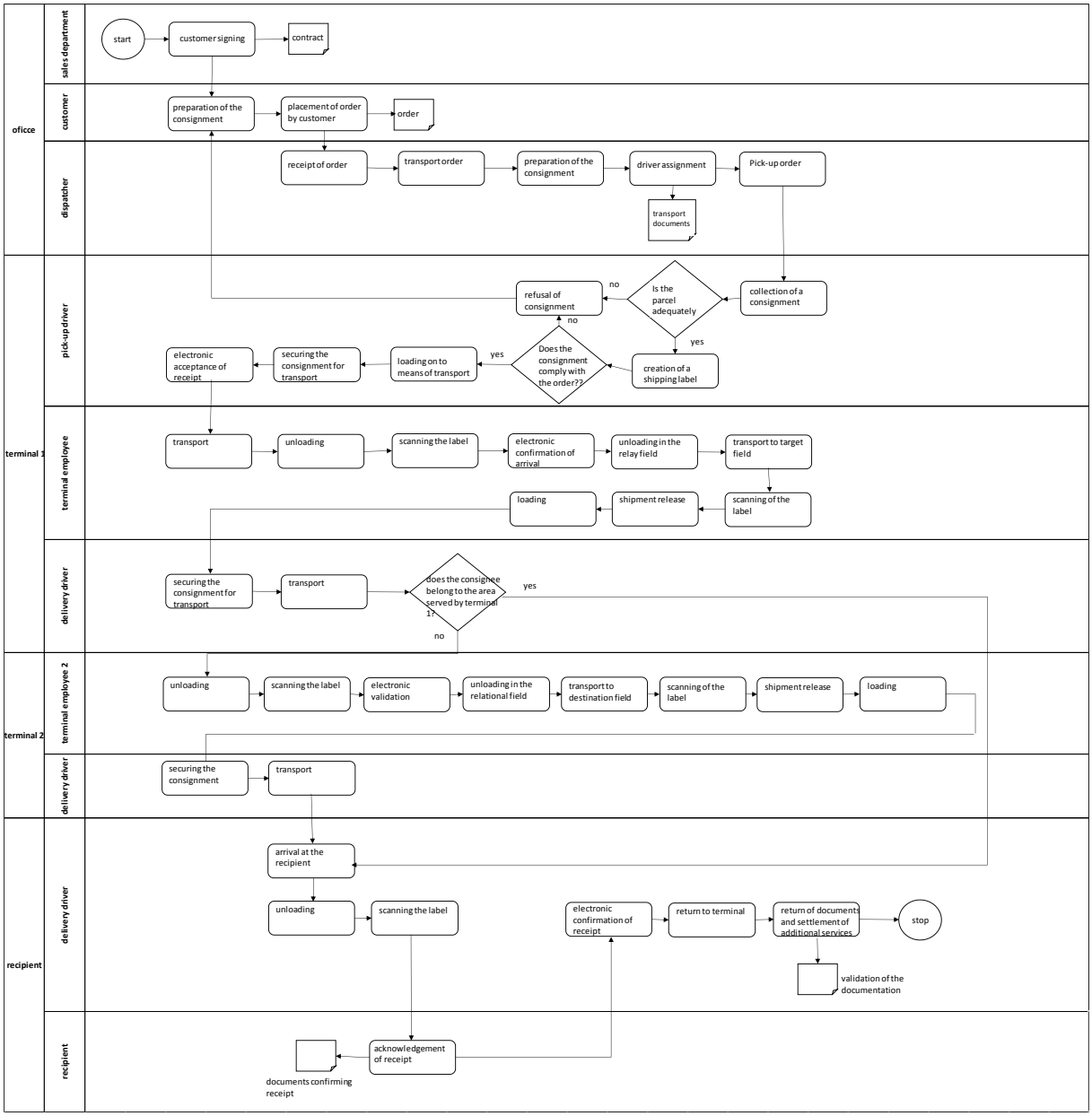

Figure 1. Map of the process of execution of the transport order of pallet shipments.

Source: Own elaboration based on information of logistics operator.

The order fulfillment process includes all activities that occur during the transportation of a particular cargo shipment. The process begins when the sales department acquires a customer. The customer packs the shipment and secures it properly and generates an order in the system. The order automatically appears in the company's system and the employees of the department dealing with a given customer and region proceed to execute it. Dispatchers create shipping documents and send a driver to the pickup site, the driver must scan each pallet being taken up, and check it against the documents. When the shipment matches, the driver visually inspects it for proper security, and when everything matches, he can load it onto the truck. Otherwise, he has the right to refuse the shipment or ask for additional security or repacking. On the means of transport, the driver is also required to secure the shipment with the appropriate equipment so that it is not damaged during the journey. Once the shipment arrives at the terminal, it is unloaded, everything is scanned once again, so that the message about the shipment's stay at the terminal is sent to the company's system. The goods are located on a relay field at the unloading dock, after which terminal personnel transport them to the appropriate relay field, from where they are picked up by a driver to be digested to the terminal serving the specified region where the shipment is to ultimately arrive. The same loading procedures are repeated, i.e. scanning the labels, loading and securing for transport, and the transport itself. At this terminal, unloading, scanning, deployment to relational fields takes place, until finally transport to the shipment's final destination. There, the driver unloads the pallet units, gives the documents to the person authorized to receive them to sign, then approves everything on a mobile device or phone. Once back at the terminal, he gives the documents back to the appropriate department so they can be accounted for.

Of course, from the analysis of the process itself, the number and type of damage to pallet shipments is not clear, so data analysis of the number of pallet units transported each day over 6 months and the number of damaged shipments was carried out. These data are presented in Table 1.

The collected data shows that all shipments involved in the transportation process in 6 months are 912686 of which 1014 shipments were damaged. The highest percentage of damaged shipments occurred in the area - terminal, as it is, as many as 745 of all damaged shipments, which is 73.5%. The smallest number of shipments that were damaged originated through the driver, and this is 46 shipments, or 4.5%. After analyzing the data, one can proceed with further analysis, and the first step is to select the appropriate scale and ratings to suggest when conducting the FMEA analysis. Table 2 defines the probability of failure (P). The probability with which a given defect can occur, its characteristics, the P rating on a scale of 1-10, and the estimation of the ascension of a defect are specified.

Table 1.
Data analysis of the number of pallet units transported over 6 months

YEAR	MAY			JUNE			JULY			AUGUST			SEPTEMBER			OCTOBER		
2023	DAY	number of pj	number of pj damaged	DAY	number of pj	number of pj damaged	DAY	number of pj	number of pj damaged	DAY	number of pj	number of pj damaged	DAY	number of pj	number of pj damaged	DAY	number of pj	number of pj damaged
	01.05.2023	7389	3	01.06.2023	4569	5	03.07.2023	5169	8	01.08.2023	5632	1	01.09.2023	5632	12	02.10.2023	8563	15
	02.05.2023	7521	1	02.06.2023	7896	12	04.07.2023	7523	9	02.08.2023	5236	2	04.09.2023	5236	9	03.10.2023	7456	9
	03.05.2023	6987	1	05.06.2023	7896	8	05.07.2023	6452	10	03.08.2023	5478	5	05.09.2023	5478	8	04.10.2023	5627	8
	04.05.2023	6589	5	06.06.2023	7820	9	06.07.2023	6410	7	04.08.2023	8651	8	06.09.2023	8651	7	05.10.2023	6890	1
	05.05.2023	5698	8	07.06.2023	5890	5	07.07.2023	6520	6	07.08.2023	4523	9	07.09.2023	4523	5	06.10.2023	8700	1
	08.05.2023	4569	6	08.06.2023	4789	8	10.07.2023	6325	14	08.08.2023	7896	15	08.09.2023	7896	8	09.10.2023	5890	5
	09.05.2023	7896	14	09.06.2023	7600	9	11.07.2023	5632	12	09.08.2023	5879	14	11.09.2023	5879	11	10.10.2023	4789	4
	10.05.2023	7896	7	12.06.2023	5210	6	12.07.2023	5236	8	10.08.2023	6987	18	12.09.2023	6987	19	11.10.2023	7600	125
	11.05.2023	7820	6	13.06.2023	8765	11	13.07.2023	5478	1	11.08.2023	5687	9	13.09.2023	5687	2	12.10.2023	5210	19
	12.05.2023	5890	5	14.06.2023	7856	5	14.07.2023	8651	2	14.08.2023	5478	8	14.09.2023	5478	8	13.10.2023	8765	36
	15.05.2023	4789	5	15.06.2023	8563	2	17.07.2023	4523	6	15.08.2023	5784	1	15.09.2023	7856	10	16.10.2023	7856	5
	16.05.2023	7600	5	16.06.2023	7456	1	18.07.2023	7896	3	16.08.2023	8547	2	18.09.2023	8563	9	17.10.2023	4569	1
	17.05.2023	5210	2	19.06.2023	5627	1	19.07.2023	5879	5	17.08.2023	6547	3	19.09.2023	7456	15	18.10.2023	7896	4
	18.05.2023	8765	1	20.06.2023	6890	1	20.07.2023	6987	3	18.08.2023	4569	4	20.09.2023	5627	4	19.10.2023	7896	7
	19.05.2023	7856	1	21.06.2023	8700	1	21.07.2023	5687	6	21.08.2023	7896	1	21.09.2023	6890	8	20.10.2023	7820	8
	22.05.2023	8563	1	22.06.2023	6800	7	24.07.2023	5478	4	22.08.2023	7896	5	22.09.2023	8700	9	23.10.2023	5890	9
	23.05.2023	7456	3	23.06.2023	6984	8	25.07.2023	5784	5	23.08.2023	7820	8	25.09.2023	9874	1	24.10.2023	4789	6
	24.05.2023	5627	8	26.06.2023	6547	14	26.07.2023	8547	1	24.08.2023	5890	8	26.09.2023	8965	9	25.10.2023	9870	9
	25.05.2023	6890	7	27.06.2023	6987	15	27.07.2023	6547	1	25.08.2023	4789	5	27.09.2023	8521	8	26.10.2023	9600	16
	26.05.2023	6800	9	28.06.2023	7896	6	28.07.2023	5647	8	28.08.2023	7600	2	28.09.2023	8540	16	27.10.2023	8960	18
	29.05.2023	6984	4	29.06.2023	6999	8	31.07.2023	6325	9	29.08.2023	5210	1	29.09.2023	8740	7	30.10.2023	8942	1
	30.05.2023	6547	7	30.06.2023	8796	7				30.08.2023	8765	4				31.10.2023	9752	1
	31.05.2023	6987	1							31.08.2023	7856	1						
	total	158329	110	total	156536	149	total	132696	128	total	150616	134	total	151179	185	total	163330	308
	Damage passage			Damage passage			Damage passage			Damage passage			Damage passage			Damage passage		
	way	driver	Terminal	way	driver	Terminal	way	driver	Terminal	way	driver	Terminal	way	driver	Terminal	way	driver	Terminal
	25	2	83	39	12	98	22	9	97	34	8	92	31	9	145	72	6	230

Source: own compilation based on data received from the operator.

Table 2.
Probability of damage

probability of occurrence of the event	characteristics	points	estimation
almost unlikely	damage is alomst impossible	1	less than 1/100000
very rare	several small defects	2	1/2000
rare	minor defects	3	1/4000
average	medium damage (quantity and quality)	4-6	1/1000, 1/400, 1/80
frequent	repetetive damage	7-8	1/40, 1/20
very frequent	unavoidable	9-10	1/8, 1/2

Source: own elaboration (after consulting the company).

Table 3 shows the significance of the damage also rated on a scale of 1-10 (S) respectively for damage ranging from very small and insignificant to very large, which generates further problems. Table 4, meanwhile, shows the probability of detecting damage. Table 5 shows the problem analyzed using the FMEA questionnaire, which is related to the impact of security features on pallet shipments.

Table 3.
Significance of the damage

Significance of the threat		S
very small	minimal impact on the process, with no impact on other consignments or persons involved	1
small	slight inconvenience, other consignments may flow correctly	2-3
medium	other processes may be disrupted further	4-6
large	major problems, with the result that other processes are more likely to be disrupted downstream	7-8
very large	major problems, other processes are disrupted further downstream generating damage repair costs	9
	a major constraint on the realisation of the logistical (transport) process, its stoppage, its violation	10

Source: own elaboration (after consulting the company).

Table 4.
Probability of detecting damage

level of detection	probability of damage detection	D
very high	very high shipment and process security	1-2
high	low probability of undetected damage	3-4
medium	little difficulty in detecting damage	5-6
low	low ability (possibility) of damage detection	7-8
very small	high possibility of damage detection	9-10

Source: own elaboration.

Table 5.
The analyzed problem with the help of the FMEA questionnaire

	Problem	Cause of the problem	Consequences of the problem	Current state				Improvement activities	Revised condition			
				P	S	D	C		P	S	D	C
1	Damage to palletised shipments - through poor security	No safety beams	Shipment shifting while in transit, crushing, falling out of the means of transport. Damage or destruction of goods. Possible damage to the health of those involved and other consignments.	5	9	1	45	Introduce the use of beams irrespective of vehicle loading.	2	9	1	18
2		No tie-down straps	Shipment shifting while in transit, crushing, overturning, falling out of the means of transport. Damage to or destruction of goods. Damage to or destruction of goods. Possible damage to the health of those involved and other consignments.	4	8	1	32	Training of employees and drivers in relation to the use of security features.	3	8	1	24
3		Lack of control by the driver	Occurrence of damage that went unnoticed causing further problems and costs.	5	7	5	175	Introducing a function on the mobile device about the need to confirm the security check as a reminder.	1	7	2	14
4		Lack of control by a terminal employee	The occurrence of damage that went unnoticed causing further problems and costs for the company.	4	7	5	140	Introducing a function on the mobile device about the need to confirm the security check as a reminder.	1	7	2	14
5		Wrong packaging	Poorly secured goods, hardly susceptible to transport and handling.	3	10	7	210	Penalties for shippers for poorly packaged shipments and their thorough training.	2	10	5	100
6		Incorrectly selected protection	Poor securing of goods or failing to secure them and exposing them to multiple damages and unfitness for transport.	7	10	6	420	Introducing a function on the mobile device about the need to confirm the security check as a reminder.	4	10	2	80
7		Defective packaging	Damage to the goods through defects in packaging or insufficient protection from damage.	3	5	5	75	Penalties for shippers for poorly packaged shipments and their thorough training.	2	5	4	40
8		Defective security	Poor securing of goods or failing to secure them and exposing them to multiple damages and unfitness for transport.	4	6	6	144	Introduce systematic security checks on company consignments to reduce unusable ones.	3	6	5	90
9		Too few safeguards	Poor securing of goods or failing to secure them and exposing them to multiple damages and unfitness for transport.	7	4	6	168	Training of employees and drivers in the types of security features of the consignments concerned.	4	4	4	64
10		Irresponsible handling of a consignment	Damage to the consignment and its security features, causing further damage and costs.	7	3	7	147	Greater emphasis on incurring criminal consequences for employees who do not comply with parcel handling rules.	2	3	5	30
11		Improper labelling of the consignment	Damage to the consignment and its security features, causing further damage and costs.	7	3	4	84	Penalties for shippers for poorly packaged shipments and their thorough training.	3	3	4	36
12		External factors (e.g. weather conditions, traffic accidents)	Damage to the consignment and its security features, causing further damage and costs. Damage or destruction of the goods.	2	7	9	126	Lack of	2	7	9	126

Source: own elaboration.

FMEA (Failure Mode and Effects Analysis) is an effective tool for identifying potential hazards, causes of damage and their impact on the pallet shipment process. The following are steps that can be taken to conduct an FMEA analysis in the context of the causes of damage to pallet shipments:

Step 1. Define the Process

The transportation process was analyzed. Data was collected on the number of pallet units transported each day over 6 months and the number of damaged shipments also occurring on each day of the month. Days on which the company does not work, i.e. weekend days and non-working holidays, were omitted. The process described was considered in view of the realization of transports when maximum loading of the vehicle occurs, not just parts of it, as such transports are a rarer phenomenon.

Step 2. Identification of Components

In this step, a map of the transportation process was made.

Step 3. Identify Possible Damages.

Potential damages that may occur were identified.

Step 4. Identify Causes

Possible causes were identified for each potential damage.

Step 5. Identify Effects

The effects of the potential damage were identified.

Step 6: Determine Probability of Occurrence

Assign. each potential damage a probability of occurrence.

Step 7. Determine Ease of Detection.

Evaluate how easy it is to detect each potential damage before it affects the process.

Step 8. Calculate Priorities

For each potential damage, an FMEA priority was calculated, which is the product of an assessment of probability, impact and ease of detection. This priority will help identify the riskiest areas.

Step 9. Implement Corrections and Monitoring

Based on the results of the FMEA analysis, action plans were developed to minimize the identified risks.

After conducting the FMEA and analyzing the results, it can be deduced that the root cause of the problem that received the highest risk rating is misplaced security. The rating it received is, as high as 420, and it differs significantly in scale from the other causes of shipment damage. Only this one number exceeds the threshold of 300, and to such a high degree, which suggests that the problem is quite serious and should be looked at even more closely and, as a first step, proceed to reduce it as soon as possible to avoid further problems and their subsequent consequences, including financial ones. When performing the analysis, the solution that was proposed to lower the risk threshold was to introduce a function on the mobile device about the need to confirm the security check as a reminder. This means that the employee who was

loading and securing the goods at the time would have to dutifully confirm an automatically displayed query during scanning whether the security features had been correctly applied and checked in sequence. This proposal would not only help reduce the risk, down to level 80 for the biggest problem, but also reduce other problems such as the driver's failure to check and the terminal employee's failure to check.

This would have the effect of eliminating the occurrence of damage, since it would have been noticed earlier during the inspection and would not have had the chance to cause further problems, as well as costs. As a result, their risk would also be reduced almost to non-existent. There are also other damage-causing risks, and these were also examined during the performance of the analysis, but none of them cause such a "jump" as the one discussed above, but for them, too, proposals have been made to lower them, which in turn results in lowering the risk assessment of their occurrence. In the problems that occur and have been studied, there are also those that will not be affected by any improvement measures that could be proposed. Such problems are caused by fortuitous events beyond anyone's control, such as weather conditions or traffic accidents with accidental participation. These are fortuitous events beyond the company's control and cannot be predicted, and unfortunately the effects are usually very noticeable.

The difficulty of securely securing a shipment is caused by poorly selected security, which is inadequate not only in terms of the strength and alignment of its physical characteristics, but can also be detrimental to the shipment itself. This problem mainly involves the terminal, and this is where preventive measures should be implemented. Certainly, control by drivers should be increased by introducing a function on the mobile device about the need to confirm security checks. Next, it is necessary to get the security features right for the goods through instructions and the introduction of a function on the mobile device about the need to confirm security checks. It will also be necessary to train employees and drivers on the types of security features for given shipments. There should also be greater emphasis on incurring criminal consequences for shippers and employees who do not comply with shipment labeling. It is also advisable to introduce systematic security checks of shipments at the company to reduce those unfit for use, and better quality packaging should be used and more emphasis should be placed on proper packaging and securing of shipments.

In conclusion, it can be said that the analysis of the transportation process was presented using the process mapping method, in which the individual steps that are taken to get the shipment from the starting points to the destination point were determined, taking into account the many activities on its way. During observations at the company, data was collected, and their analysis made it possible to note that the greatest number of all damages are caused within the terminal, this represents, as much as about 73.5% of all damages. Therefore, all actions should start in this area and focus their attention on it. Subsequently, an FMEA analysis was carried out, which made it possible to detect and analyze problems related to damage to shipments. From here it emerged that the biggest problem faced by the company is

misplaced security, caused by incorrectly securing the goods or not securing them, and thus exposing them to numerous damages and even unfitness for transport. Its assessment differs significantly in outcome from the other risks, which means that it should be focused on first. The FMEA analysis introduced in the study influenced the detection of the main causes of the occurrence of hazards in the loading and transportation of goods and people in this loading space.

4. Conclusive remarks

The safe transportation of pallet shipments is a key element in the logistics process. Whether you are a manufacturer, distributor or consignee, you need to ensure that your shipments arrive at their destination in perfect condition. The study shows that:

- most of all damage occurs within the terminal, it accounts for, as much as about 73.5% of all damage,
- the biggest problem faced by the company is erroneous security, caused by incorrectly securing the goods or not securing them, and thus exposing them to numerous damages and even unfitness for transport.

Preventive measures that can help avoid damage that occurs during the execution of pallet shipment shipments can be modifications to mobile devices and the introduction of a new function there - confirmation of security checks, to remind people to perform this action.

To ensure the safe transportation of palletized shipments, there are several important factors to consider. The first step in securing the transportation of pallet shipments is to choose the right logistics provider. It is important to find a company that has experience in transporting this type of shipment. The second aspect is securing the shipment during transport. There are many ways to secure pallet shipments during transport. These can include safety straps, safety tapes, anti-slip pads or other specialized devices. These items prevent shipments from shifting or being damaged during transport. To ensure the safety of pallet shipments being transported, the logistics operator should follow proper handling procedures. Shipments should be moved using specialized equipment, such as forklifts, which minimize the risk of damage. It is also important that personnel are properly trained in handling pallet shipments.

When choosing a logistics provider, it is worth checking whether it offers insurance for pallet shipments. A good logistics company should have adequate insurance to protect shipments in case of possible damage or loss. This type of insurance gives the customer a sense of security and protection in case of unpredictable events. Another aspect of pallet shipment security is access to a tracking system. The logistics operator should provide the customer with an online system to monitor the location of shipments and check their status in real time. This allows you to react quickly to any problems, such as delays or lost shipments. Security of

pallet shipments is an extremely important part of the logistics process. Choosing the right operator, using the right safeguards during transport, proper handling procedures, insuring shipments and having access to a tracking system are key elements to consider. Attention to these aspects ensures the safe transportation of pallet shipments and guarantees that they will arrive at their destination in perfect condition.

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