# EFFECTIVE WAYS OF LOADING AND UNLOADING CARGO
# *EFEKTĪVI KRAVU IEKRAUŠANAS UN IZKRAUŠANAS VEIDI*

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**Abstract.** *Efficient loading and unloading of cargo is an important process in various industries including logistics, transportation and shipping. This article provides a comprehensive overview of the various methods and technologies used in cargo handling to streamline operations, increase productivity and reduce risk. The discussion begins with traditional manual approaches, such as palletizing and manual handling, and moves on to consider automated solutions. Integrating current research findings and industry practices, the article provides insight into the evolving cargo handling landscape, paving the way for more efficient and sustainable logistics operations in the future.*
**Keywords:** *cargo handling, loading cargo, unloading cargo.*

## Introduction

The continuous growth of the world population and of its standard of living, combined with the depletion of local resources, increases the dependence of the world economy on international trade. The term *cargo* refers to the goods or merchandise conveyed in a ship, airplane or vehicle. Thus, freight becomes a meaningful part of the international trade.

Load transportation is an extremely risky operation. Moving things around may seem like a straightforward task, but loading, unloading, and moving freight can result in serious harm or even death. If cargo workers do not follow the proper loading and unloading safety protocols, they run a considerable risk of being struck by or falling on big things. Maintaining employee safety and keeping one's warehouse organized requires the observance of the appropriate safety protocols.

**The aim of the research** is to recognize, compare, and assess diverse strategies and innovations to optimize productivity, security, and cost-effectiveness in various ways of handling cargo.

**The objectives of the research** are:

- to evaluate freight unloading methods, emphasizing skilled labour's role and safety;
- to depict the ways of loading ships in port operations;
- to present the process and equipment involved in loading air freight;
- to analyse the loading procedures for vehicles and bulk products onto rail cars.

**Research method**. Scientific literature analysis.

The results of the research are provided in the concluding part of this paper.


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## Freight unloading

One of the most common and used terms in Logistics industry is “unload freight”, which is the process of taking items out of a vehicle, trailer, or container after they have been moved from one point to another. Even though this is primarily a manual procedure, it is not a job for inexperienced labour. Typically, loaders, or skilled and experienced labourers, perform the unloading of freight. These experts are hired on a project basis to complete the tasks assigned to them. When their work is completed and approved, they leave until they are asked to complete that specific service again. There are also many methods that loaders apply to unload freight (*Express Freight Handlers, Inc., 2023).*

The first method is hand unloading. It may be possible to physically unload a truck in some situations. This generally happens when there are only a few heavy objects that need to be unloaded and they are small enough for one or two persons to handle. If a pallet jack is accessible, one can also hand unload a truck by using it. The delivery driver does not help move the load in these situations. If one is unable to unload by hand, they should employ one of the different methods available, so this method is usable when the freight is not heavy and can be unloaded by people’s hands and force *(Ait, 2021).*

The second method can be tailgate unloading. One can use a tailgate unload, depending on the size of the cargo. This is the process of moving the load to the tailgate or the back of the vehicle and unloading it there. When using the tailgate method, one needs to be prepared to take packages from the ground, so if they are too heavy, the pallet jack would help significantly.

It is difficult to miss a truck or trailer with a tailgate installed. The weight of these big, hefty pieces of equipment significantly increases the gross vehicle weight. The conventional lift gate raises and lowers the gate by forcing a piston through a cylinder with the help of hydraulic pressure. Usually, a control box with a straightforward “up” and “down” function is used to regulate them *(FinSMEs, 2018).*

The third method can be freight unloading using a forklift. A forklift may be used to unload the majority of trucks and loads. Forklifts can be hired easily, and on-site tradesmen frequently have high-risk forklift licenses. This is one of the easiest methods to unload a delivery truck, and it is highly recommended. Some loads, however, may be too heavy or too large for a forklift to safely unload; this can happen when the load exceeds the recommended weight or dimension limits of the forklift *(Ali, 2023).*

Forklifts are the best option for ensuring a smooth operation while handling big, heavy, and palletized goods. They are perfect for unloading shipping containers and vehicles, among other modes of transportation *(Bremco, 2024).*

It is imperative that one follows a few rules while loading a forklift truck in order to guarantee both efficiency and safety. These are the steps that need to be followed:

- Recognizing the forklift’s purpose: one has to remember that forklifts are made especially to lift and move materials. They are only meant to be used for the transportation of goods *(Ali, 2023).*
- Examining the environment: one should always be mindful of the surroundings and keep an eye out for information that specifies guidelines or limitations, such as the highest clearance heights or floor load capabilities. Additionally, forklift truck operators must keep their eyes out for any objects above that could be hit when lifting the top *(Hinz, 2022).*
- Examining the cargo: one should make sure that the cargo is stable, undamaged, and packed correctly before lifting anything. A load should not be lifted if it seems not secure or if it has been damaged in a way that could lead to instability *(Hinz, 2022).* Additionally, if the size and weight of the items that a forklift lifts are not properly accounted for, they can present serious issues. Safety, therefore, has to come first in every aspect of the loading and unloading procedure *(Chisolm, 2023).*

The fourth method can be unloading freight via a crane. This method is mainly used in heavy constructions. When operating a crane, one may unload using open vehicles. This method works well when a forklift is unavailable, or with really big or massive loads. Before unloading a crane, it is important to be aware of any movement constraints and obstacles, such as buildings or power lines.

Types of cranes:

- Mobile cranes: these cranes are flexible due to their wheels and versatility. Rough-terrain cranes, built to handle challenging conditions, and truck-mounted cranes, which are truck-mounted for convenient transport, are included in this category *(MaximCrane, 2024).*
- Tower cranes: an essential tool for building big structures, tower cranes are fixed to the earth on a concrete slab. They can effectively lift heavy things to large heights, given their enormous height *(Eusebio, 2019).*
- Overhead cranes: usually seen in factories and warehouses, overhead cranes are suspended on a structure that runs the length of the building. They provide horizontal movement along the beam, which makes material handling effective *(Ur Rehman, 2023).*
- A most innovative method can be unloading freight by using Hiab. Hiab is an international innovator in the supply of intelligent services, smart and connected solutions, and on-road load handling equipment. A truck classified as a Hiab, includes a loader-crane on the back that uses hydraulics to harness the engine's power. In situations where a forklift or crane cannot be used, this method works effectively for unloading large and medium-sized goods, and is the most advanced method.
- Telescopic cranes: these cranes have a boom made of several tubes inserted one inside the other. Their shape allows for flexibility in reaching different distances, which makes them appropriate for activities requiring flexible reach *(Ur Rehman, 2023; Everything Cranes, 2022).*
- Loader cranes: designed for loading and unloading cargo, loader cranes are mounted on trucks. They are useful in logistics and transportation for the reason of their mobility and capacity to deliver cargo to various areas *(Eusebio, 2019; Cranepedia, 2021).*
- Crawler cranes: Crawler cranes provide stability and movement on difficult terrain since they are mounted on an undercarriage with tracks. They are perfect for construction sites where the ground can be uneven *(Ur Rehman, 2023; Maxim Crane Works, 2022).*

Recognized for producing high-quality cranes, Hiab leads the industry in truck-mounted crane sales. In the modern world, it is also one of the most well-known brands of articulated and truck-mounted cranes.

## Loading ships

Cargo conveyed by sea can be delivered using a great range of packing, but most sea cargo is transported in containers. The stowage of containers on a container ship is meticulously planned to maximise space, maintain ship stability, and ensure quick loading and unloading at ports.

1. Full container load (FCL). An FCL is a transport that uses the entire weight or volume of a container. An inadequate container in terms of its structure could collapse because of the weight of the containers placed above. While containers are designed to sustain up to 8 times their weight, a small structure flaw would make them crash. This occurs with hundreds of containers each year. The frame must be straight, the lashings used to lift and secure the container on the ship or truck must be in the right place, the doors must close and rust should not be visible *(Caraiani, 2008).*

2. Less than container load (LCL). Individual cargoes that are too small to fill a whole container are called cargo for a container filled partially (or LCL) and are joined by a sea carrier or a Non-Vessel-Operating Common Carrier (NVOCC) with other cargo, being loaded together in a container. Due to the repeated handling of the goods, it is mandatory that the goods be divided into pallets or placed in a crate or box, being well protected from water *(Caraiani, 2008).*

Cargo in small packages consists of the goods that cannot be placed in a container because they are too big to fit into a usual container or because they weigh more than the container limitations. A lot of cargo gets shipped in small packages. Such goods are placed directly into the ship's hold and must be wrapped differently from cargo in containers. The cargo in small packages is handled more often than the cargo in containers, as it can be firstly loaded in a truck or a coach to the harbor, to be unloaded and loaded again on a ship *(Caraiani, 2008).*

A container ship is loaded by positioning containers according to the pre-planned stowage arrangement using cranes, stacking them in designated slots on the ship's deck and hold, and securing them to ensure stability and safety during transit. Cranes lift the containers from the ground and carefully place them onto the ship's deck. Multiple containers can be handled at once, speeding up the loading process significantly *(Smoteks, 2024).* As the containers are lifted high into the air, the crane operators rely on hand signals and communication systems to ensure seamless coordination. Each container is positioned with utmost accuracy. Once on board, the containers are meticulously stacked using a specialized on-deck arrangement. This stacking method optimizes space and ensures maximum cargo capacity *(Smoteks, 2024).*

A ship-to-shore (STS) crane is a large piece of equipment, most commonly used in port operations to load and unload cargo containers from ships (see Figure 1).

Figure 1. **Ship-to-shore crane** *(Pakpedia, 2017)*

STS cranes are often found at container terminals and they play a critical role in ensuring the efficient functioning of ports. When mounted on rails, STS cranes can move along the pier to reach various berths. They can lift multiple containers simultaneously, which makes them indispensable for handling big loads in ports. The STS crane is positioned next to a ship when it docks. Joysticks and control panels are used to manoeuvre the crane after it is lowered onto the deck. The operator positions the spreader above the container and activates the mechanism to secure it. The crane operator can move the container to the desired location once it is lifted, onto a vessel, or on the storage area. Figure 1 above shows a ship-to-shore crane situated next to a transport and it brings out the crane's gigantic outline and complicated apparatus of this

machine that plays a vital part in harbour operations. The picture captures the pith of oceanic coordination, delineating the perplexing move between vessels and the foundation required to encourage the development of cargo. The sharp lines and points of the crane's plan bring out a sense of productivity and control, emphasizing its capacity to handle overwhelming loads with exactness.

To safeguard against rough sea conditions, containers are secured in place using bracing, twist locks, and other specialized locking mechanisms. Every twist lock and securing mechanism plays a crucial role in maintaining the stability of the cargo during the voyage. The crew works diligently to secure each container, knowing that proper stacking and securing are essential for the safety of the ship and the cargo *(Smoteks, 2024).*

## Loading an aircraft

A pallet filled with cargo is the initial step in loading airfreight. The dimensions of cargo planes make these pallets available in standard, 10-foot, and 20-foot lengths. A variety of cargo can be air freighted. Unit load Devices (ULDs) are aluminium boxes with profile frames that permit netting to snap effortlessly, and there are also specialized unit load devices. Forklifts or other lift trucks are used to load the cargo before it is ready for transport. Most planes are loaded through hatches in the side or rear of the plane. Some planes also make use of a nose hatch for larger cargo *(PHL, 2018).*

There are different types of aircraft used in cargo transportation:

- Wide-body aircraft have two aisles running from the front to the back of the cabin, they are also known as twin-aisle aircraft. Long-haul flights between airline hubs and important destinations are typically operated using them. The ULD is used to load freight aboard the cargo compartment (see Figure 2).

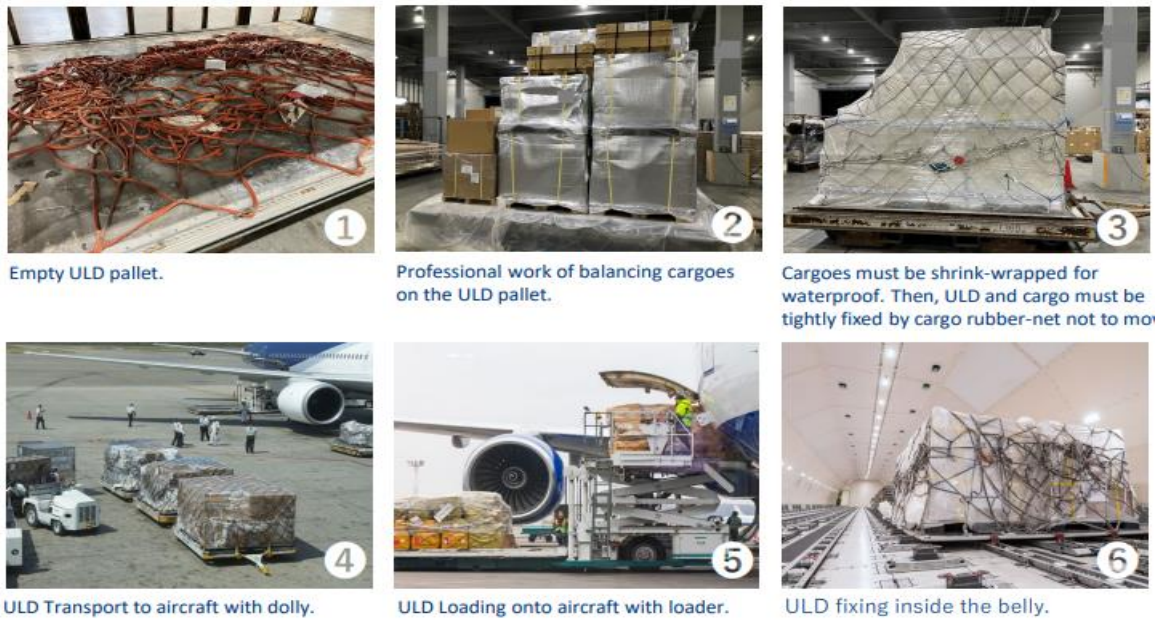


Figure 2. **Ways of Loading an aircraft** *(Hankyu Hanshin Express, 2022)*

- Single-aisle aircraft is another term for narrow-body aircraft. Compared to wide-body aircraft, they have been used for shorter or medium-distance trips carrying a smaller number of people. Converting passenger planes to cargo freighters has been popular nowadays *(Aviation Learnings Team, 2020).*

## Loading rail vehicles

Handling cargo by rail mainly is distinguished into two parts: the rail vehicles and the bulky product transportation. Rail vehicles are loaded as mentioned below:

Vehicles are driven on and off auto racks using portable ramps, which are used to drive vehicles onto and off auto racks. Auto ramp operators open the doors at one end of the auto rack first. The ramp reaches the end of the auto rack and is secured at the level where it is going to be unloaded. The ramp can be used to safely drive cars, trucks, and sport utility vehicles (SUV) into or out of the rail car *(Track Record, 2021).*

Loading equipment for Bulky products, e.g. rail cars (the LB Industrial system version) consists of a storage silo built on grade or on a support structure that receives bulk material pneumatically conveyed from the plant (see Figure 3).

Figure 3. **Pneumatic Railcar Loader** *(LB Industrial System, n.d.)*

A series of air conveyors is used to move the material to the retractable load out spout. A dust collector on the load out spout pulls a slight draft during load out to prevent dusting. The weight in the car is measured using rail scales, and a control system fills it to the correct gross weight, as programmed by the operator. The silo support structure can be equipped with an operator control booth to monitor loading operations *(LB Industrial System, n.d.).*

The system is designed for the efficient loading and unloading of railcars with granular or powder substances by means of pneumatic vacuum or pressure systems.

The advantages, such as reduced manual labour and shorter loading times or a reduction of product loss or contamination, are the effect of the use of pneumatic load systems.

## Conclusions

1. The logistics sector provides a variety of unloading techniques, ranging from manual labour to cutting-edge technology like Hiab loader-crane systems, each appropriate for a particular type of cargo and operational requirements. Logistics experts can guarantee effective and fast offloading procedures, which will support the seamless operation of the supply chain, by carefully assessing variables including cargo size, equipment availability, and safety standards.
2. Sea cargo is usually shipped in containers. The stowage of containers is planned to optimise loading and unloading at ports. A Full Container Load is a transport that uses the entire volume of a container, whereas a Less than Container Load is the transport of the individual cargos that does not fill a whole container. A container ship is loaded by using cranes. Once on board, the containers are stacked and secured in place using locking mechanisms as bracing and twist locks.

3. Pallets of cargo must be carefully coordinated during the airplane loading process, which is made easier by ULDs and specialized tools such as forklifts. While conversions of single-aisle aircraft into cargo freighters reflect changing transportation patterns to satisfy a variety of travel durations and cargo demands, wide-body aircraft effectively accommodate ULDs for long-haul trips.
4. Rail loading operations use effective techniques including pneumatic systems for loading large products and movable ramps for loading vehicles. By streamlining the procedure, these devices minimize manual effort and shorten loading times while guaranteeing precise and safe loading. Utilizing cutting-edge machinery, such as pneumatic railcar loaders, increases overall efficiency and effectiveness in train loading operations by providing extra advantages including decreased product loss and contamination.

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