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Article

Gray TEU repositioning a sustainable circular economy commitment

Reposicionamiento de TEU grises un compromiso de economía circular sustentable

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Abstract

The imbalance between imports and exports in global trade generates, consequently, the relocation of gray TEUs on the Transpacific and Transatlantic routes. Moreover, the objective of this research was to analyze the relocation of empty TEUs on the Transpacific and Transatlantic routes. for the purposes of commitment to a sustainable circular economy. On the other hand, the fluidity of global trade depends on the containerization available for export. However, ports that do not have assets will consequently face shortages and will have to be relocated. A mixed analysis was carried out on the relocation of gray TEUs on the Transpacific and Transatlantic routes; based on the quantification and estimation of statistical control variables, decision making, modernization and information and communication technologies. The characterization of data obtained from the relocation of gray TEUs is the basis of the commitment to circular economy and sustainability. The identification of manufacturing processes for recycled TEU will be the subject of future work.

Gray TEU repositioning a sustainable circular economy commitment		
Objectives	Methodology	Contribution
Analyze the relocation of empty TEUs on the Transpacific and Transatlantic routes. for the purposes of commitment to a sustainable circular economy.	This research had a mixed approach, applying both quantitative and qualitative technologies, using systematic processes, as well as records and estimated data.	The characterization of data obtained from the relocation of gray TEUs is the basis of the commitment to circular economy and sustainability.

Elocation empty TEU, Repositioning empty TEU, Global empty container movements

Resumen

El desbalance entre importaciones y exportaciones del comercio global genera en consecuencia, la reubicación de TEU grises en las rutas Transpacífica y Transatlántica. Por otra parte, el objetivo de esta investigación fue analizar la reubicación de TEU vacíos en las rutas Transpacífica y Transatlántica. con fines de compromiso de economía circular sustentable. Por otro lado, La fluidez del comercio global depende de la contenerización disponible para exportación. Sin embargo, los puertos que no cuentan con activos enfrentarán, en consecuencia, escasez y tendrán que ser reubicados. Un análisis mixto fue realizado en la reubicación de TEU grises en las ruta Transpacífica y Transatlántica basado en la cuantificación y estimación de variables de control estadísticas, toma de decisiones, modernización y tecnologías de la información y comunicación. La caracterización de datos obtenidos de la reubicación de TEU grises son base del compromiso de economía circular y sustentabilidad. La identificación de procesos de manufactura para el reciclado TEU será motivo de trabajos futuros.

Reposicionamiento de TEU grises un compromiso de economía circular sustentable		
Objetivos	Metodología	Contribución
Analizar la reubicación de TEU vacíos en las rutas Transpacífica y Transatlántica. con fines de compromiso de economía circular sustentable.	Esta investigación tubo un enfoque mixto, aplicando tecnologías tanto cuantitativas como cualitativas, utilizando procesos sistemáticos, así como registros y datos estimados.	La caracterización de datos obtenidos de la reubicación de TEU grises son base del compromiso de economía circular y sustentabilidad.

Reubicación de TEU vacíos, Reposicionamiento de TEU vacíos, movimientos globales de contenedores vacíos

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Introduction

90% of world trade is carried out by maritime means of transport and it is of great importance to highlight that around 65% of total maritime trade is through container ships. International trade takes place on the five equatorial global sea routes; Transpacific, Asia-Europe, Transatlantic, Intra-Asian and Bab el-Manded Strait. These have some steps required by Channels such as Suez, Panama and the Channel and Straits such as Malacca, Bab el-Manded, Hormuz, Bosphorus and Oresund (Abdelshafie et al., 2022).

One of the biggest problems for shipping companies is the availability of TEU (twenty-foot equivalent unit) containers, due to the imbalance between exports and imports mainly on the Transpacific and Transatlantic routes. The arrival of container ships full of TEUs with a large amount of cargo from Asia to North America, upon their return North American exports to Asia have a decrease, which implies many empty TEUs called (gray TEUs), which will have to be relocated for future uses as a means of port packaging; consequently, consequently this affects sustainability. The aim of this research was to analyze the relocation of empty TEUs on the Transpacific and Transatlantic routes. for the purposes of commitment to a sustainable circular economy.

The characterization of data obtained from the relocation of gray TEUs is the basis of the commitment to circular economy and sustainability (Dovgal et al., 2024).

The passage of empty container ships represents a critical point in the imbalance between exports and imports. China sends many containers full of products to countries such as the United States and Canada with imports of approximately 28 million container units in 2022. However, these containers will have to be returned so that they can serve as a means of packaging for future exports. but returning a ship with few imports to China makes Shipping companies charge more for the export of products from China to the United States and Canada, because they must prorate the costs of export transportation full of products with a return of empty containers and minimal containers full of imports as cargo on ships. container ship.

How to achieve the relocation of empty TEUs with a commitment to a sustainable circular economy? The port supply chain when it is point-to-point is due to less complex logistics, but this is aggravated when the empty TEUs are transshipped in Internal or Dry Ports with transport companies that move the TEUs inland for the sequenced arrival of cargo and unloading, making transfer logistics complex and with variants of a large number of phenomena that can influence the times of the port supply chain of empty containers (Efes, 2021).

This can be a trigger for the American continent to increase its exports to Asia, Africa and Europe, placing its agro-industrial products, raw materials and crafts, with privileged shipping company expenses for its exports.

Container ships face problems due to logistics, loading capacity, expenses and monitoring of customs procedures in the relocation of empty containers. Therefore, in the reverse route of the route, if a peer client wishes to export, the route becomes bidirectional, contributing to the expenses charged by shipping companies for the relocation of TEUs.

A theory of export promotion in developing countries establishes that, if the ship is volumetrically occupied by empty and low-weight containers, they could be occupied by exporting business companies, detonating progress by selling products abroad at higher costs. transfer rates by shipping companies.

The construction of dry canals would trigger sustainable development projects, sources of work, increase in infrastructure in areas surrounding the canal, increase in capital gains in the value of the land, settlement of industrial zones, creation of companies in port areas (chemicals, mining and process) that would turn areas with high poverty rates into prosperous areas (Dovgal et al., 2024).

The identification of processes for manufacturing recycled TEUs will be the subject of future work, there by reinforcing our commitment to sustainability.

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Containerization

One TEU or twenty-foot equivalent unit (20 feet long, 8 feet wide, and 8 feet high). is the standard size, they normally load up to 24 metric tons and an empty container weighs 2.24 metric tons, therefore, the total weight will be 26.28 metric tons. But the maximum loading capacity will be 30.48 metric tons when loading with higher density products up to 28.2 metric tons. An FEU or forty-foot equivalent unit (40 feet long, 8 feet wide and 8 feet high) is twice the size of a TEU and has a tare weight of 3.7 tons.

Maritime container units are classified according to their design into 16 types of containers that protect cargo and ensure transportation via container ships to meet the requirements of the shipping industry. These are dry storage container, flat rack container, open top container, tunnel container, open side storage container, double door container, refrigerated ISO container, insulated or thermal containers, tanks, rolling container for cargo storage, mid-height containers, automobile carriers, intermediate bulk change containers, drums, special purpose containers, changeable body container.

Moreover, when a container is loaded onto a ship, it is fixed to its structure and fixing elements such as moorings, turnbuckles, twist locks, etc. are placed between containers. This prevents containers from moving out of place or falling into the sea during adverse weather conditions or high winds. The stevedores and the deck crew oversee lashing and unlashing work in port. Before arriving at the port, the crew of the container ship unstraps the containers that will be lowered to save time in the port and be able to unload the containers immediately after docking. This follows a plan and order of mooring and unmooring according to the loading and unloading plans. of the ship, because an imbalance of masses in the ship can generate an imbalance and offshore with the presence of waves it will not be possible to balance the ship with the intelligent balance system that works with the passage of water flows to the tank tanks that function as hydraulic levelers.

Methodology

This research had a mixed approach, applying both quantitative and qualitative technologies, using systematic processes, as well as records and estimated data.

Moreover, the objective of this research was to analyze the relocation of empty TEUs on the Transpacific and Transatlantic routes. for the purposes of commitment to a sustainable circular economy. For this, the application of the quantitative method was relevant in the identification of control variables involved in previous studies such as; statistics, decision making, modernization and information and communication technologies.

The characterization of data obtained from the relocation of gray TEUs is the basis of the commitment to circular economy and sustainability (de Mattos Nascimento et al., 2024). The records of results obtained by different port companies, governments of different countries, experiences of shipping and port personnel, previous scientifically reported studies of the relocation of empty containers, were considered as the application of the qualitative method that allowed the possibility of obtaining results from the estimation of variables, which played an important role in decision making to understand the proposals implemented by private, shipping and port companies in the relocation of empty TEUs.

The operational data resulting from this investigation determined that shipping companies charge more for the export of products from China to the United States and Canada, because they must prorate the costs of export transportation full of products with a return of empty containers and minimal containers full of imports as cargo on ships. container ship. Finally, through the mixed method, an analysis of the control variables was carried out that allow involvement in How to achieve the relocation of empty TEUs with a commitment to a sustainable circular economy?

The port supply chain when it is point-to-point is due to less complex logistics, but this is aggravated when the empty TEUs are transshipped in Internal or Dry Ports with transport companies that move the TEUs inland for the sequenced arrival of cargo and unloading, making transfer logistics complex and with variants of a large number of phenomena that can influence the times of the port supply chain of empty containers (Efes, 2021).

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The new and relocated TEU, FEU markets

Containerization allows for the distribution of cargo in a unified, intermodal transport through a combination of rail, road, canal and maritime transport. Every year, between 1.5 and 2.5 million TEUs are manufactured in China. Containers are standard cargo units, they are classified into three main markets: dry containers, refrigerated containers (reefers) and tank containers. (Abdelshafie et al., 2022 and Helo & Thai, 2024).

The number of total TEUs in the world was estimated at around 37.6 million at the beginning of 2019. Annual TEU production in 2019 reached around 5.2 million, due to significant trade demands and port congestion, due to a temporary shortage of containers. in world markets. In March 2020, there was a huge surplus of boxes, 3 million empty TEUs available in Chinese ports plus another 1.2 million TEUs stored with container manufacturers. Orders for new cases plummeted due to this surplus. However, the situation reversed in mid-2020, due to an increase in import demand in North America and Europe. All this linked to an increase in exports from China, caused an avalanche of orders for new containers, which doubled the price of a standard 20-foot box.

China represents 90 to 95% of the world's container production. It has four leading companies in the production of containers in their different variants, capable of building 6 to 8 million containers annually, the price of a new container can range from 3,000 to 85 million. 000 dollars according to your specifications.

Dry TEUs in their base part have a price of 3,000 to 4,500 dollars and FEUs from 4,500 to 14,500 dollars, and the most expensive TEU sector is the refrigerated ones whose price ranges from 30,000 to 85,000 dollars in 2024. Once produced, a new container is immediately moved to a nearby export activity (factory or distribution center), then loaded and taken to a container port. On the other hand, any TEU utilization strategy must consider production and relocation costs in the event of requiring repositioning over long distances (Efes, 2021 and Helo & Thai, 2024).

Manufacturing a 20-foot dry TEU has a final price of $2.30 per cubic foot. On the other hand, a 40-foot dry FEU container costs $1.80 per cubic foot. However, it is estimated that the production cost for dry TEU per cubic foot is $1.70 and for FEUs it is $0.80 per cubic foot. In the case of relocated containers, the price of the base dry TEU ranges between 1,600 and 2,500 dollars and for the relocated base dry FEU between 3,200 and 6,950 dollars during 2024 on the Transpacific route heading from North America to Asia, which balances the costs of production with relocation for dry TEU and FEU. In the case of relocated containers there are two types of business plan modalities, one with return and another where relocation is not requested, this depends on the company that charters the container, and its relocation costs depend on the type of container and the remaining useful life of the container. The useful life of a container is six trips for it to be profitable according to port standards. On the other hand, if a container does not require return because it has been acquired with that specification, it could be forgotten after the delivery of the merchandise, being a waste product for the importing country.

Another way of abandoning a container is when its useful life has ended or the owner of the exporting company does not claim it, considering it as waste packaging, so he is not responsible for the container, leaving the customer to abandon it and its fate. end with the problem, to the port storage yard, to the importing country as part of its waste, while the shipping companies and the exporting manufacturer ignore it.

This problem is of greater magnitude in base dry containers, because the relocation costs can be exceeded by the production costs, so the companies that own the containers ignore the container and replace it with a new one, because it is cheaper, however, this represents a source of global pollution. On the other hand, refrigerated containers whose price is more expensive due to the refrigeration units, the satellite tracking technologies that accompany them and the disinfection processes required before loading them. These are the focus of attention of the relocation of shipping companies and manufacturing companies that own containers due to their high costs (Efes, 2021 and Helo & Thai, 2024).

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96% of the containers that move in supply chain management in 2021 are owned by shipping companies and container leasing companies with percentages of 48% each. This allows shipping companies to cope with temporal and geographical fluctuations in container demand. By 2024, the number of single-use containers by private manufacturers without responsibility for relocation will increase to 10%.

Containers are an asset that maritime shipping companies make available to their clients. Control of container assets that allows for more efficient use of the transportation chain.

The rising cost of new containers, the cost of repositioning empty containers and competitively low freight rates that control the price of moving containers along trade routes have made the container leasing business less profitable.

Maritime carriers have the responsibility of repositioning empty containers with payment for their services, logistics companies have the responsibility of charging the exporting producer for shipping and container relocation services once the product is delivered, as well as representation and customs costs, trunk relocation costs in ports and inland and finally in the case of containers that have ended their useful life, the owner and beneficiary of the container transportation services (the shipping company that rents or the manufacturing company must take charge of a program integral responsible for the "9 Rs of the circular economy in "Containerization" (Refuse, Reduce, Reuse, Repair, Restore, Remanufacture, Redesign, Recycle and Recover) in the country of origin of container manufacturing or through transnational companies that By agreement, they responsibly support the control and management of containers.

Otherwise, it is more comfortable for companies to get rid of their assets when they stop generating financial resources. However, in containerization is as expensive to build as it is to destroy, which is a problem for exporting companies, shipping companies and private entrepreneurs who are inheriting third world importing countries with loose regulations in their territories that make them an easy flank. of abuse (de Mattos Nascimento et al., 2024, Hunger et al., 2024 and Muñoz et al., 2024).

Port Assets

The global leasing market in 2020 was 10.7 million TEU. From the point of view of shipping companies, their containers are secondary assets that allow efficient use of their vessels and control of cargo. These maximize the use of the ship, which is its main asset. As of early 2023, 18 of the top 35 shipping companies were in Asia. China is the second largest ship-owning country after Greece (first), followed by Japan (third),

Singapore (fourth), Hong Kong, China (fifth), the Republic of Korea (sixth) and Taiwan Province of China (eighth). China has a share of 11.04% of the world fleet, surpassed by Greece with 11.8%. Japanese shipowners own a 10.73% stake, Hong Kong; China is fourth in share with 8.8% of the world fleet.

Hong Kong, China has a 2.4% share of the world's fleet of vessels with a total of 2,537 vessels Hong Kong, China represents a 6.27% share of the world's fleet, placing the flag in sixth place by value of ships. Singapore fifth place, followed by China sixth place and Japan tenth place. Other flags in the top 35 include Indonesia (12), the Republic of Korea (18), India (19), Vietnam (22), Malaysia (25) and Taiwan Province of China (33).

TEU and chassis fleet leasing

Leasing companies, containers are their main asset, the objective is to amortize their investments through leasing contracts. These agreements are in terms of the duration of the lease, who is responsible for the repositioning of the empty containers. Recent trends underscore their more active role in container asset management, because a container spends a large portion of its useful life idle or being repositioned.

Container market chassis fleets are needed to transport containers by road and sometimes within terminals. They are designed to be interoperable, the chassis are adjustable to carry containers between 20 and 40 feet, while others can be adjusted to handle containers of less common sizes, such as 53 feet. Their transportation between international markets depends on separate regional segments of supply of chassis.

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A chassis can also be used to store containers in terminals and distribution centers called operations on wheels with a supply and demand perspective (Cui et al., 2022 and Ng, 2024).

A chassis supply business model is that shippers or logistics service providers own the chassis they use, major intermodal terminals, chassis groups support drayage operations by allowing motor carriers to access and return equipment, which is a predominant business model in North America. In a road transport contract, the carrier assumes responsibility for organizing all segments of the transport chain, including the provision of a motor carrier and a chassis.

The chassis market is a derived demand. The chassis market is prone to lag effects and adjustments, as chassis suppliers seek to match chassis fleets, commonly organized in regional groups, with container movements.

A container is a transport and also production unit that moves as an export, import or repositioning flow. Once a container has been unloaded, another means of transportation must be found, because moving an empty container is as expensive as moving a full container, in addition to occupying the same volume. Shipping companies need containers for their service throughout the port network, but these must be in continuous flow because a delay increases the costs of their handling, transfer and stay.

The repositioning of empty containers is one of the most complex problems in the global distribution of goods, due to the fact that cargo for return could not be found. Under normal operating circumstances around 2.5 million empty TEUs per year are stored, waiting to be used and these represent around 10% of existing active containers and 20.5% of global port handling. A trade imbalance leads to the systematic accumulation of empty containers. Conversely, a region that exports more than it import will face shortages. If this situation persists, large quantities of containers will need to be repositioned between trading partners. Repositioning costs: They include a combination of domestic transportation and international transportation costs. Container repositioning cost assessed on global stock market (Luo et al., 2021).

The relocation of TEUs on transpacific routes could spend three to four weeks in the internal port of the importing country loading it and returning it to the exporting port between 10 to 12 weeks, obtaining an income of 800 dollars in the internal port and repositioning the container through of the Pacific and generate a total return income of around $3,000 dollars, this could be higher in case of peak demand in the port system. Higher manufacturing or leasing costs may favor the repositioning of empty containers and the balance between manufacturing and repositioning the forgetting of assets to liabilities (de Almeida Rodríguez et al., 2023 and Ding et al., 2023).

The reluctance of some shipping lines and leasing companies to share market information on container positions and quantities for competitive reasons makes it difficult to establish “grey box” empty TEUs. In the North American railway system (TTX Rail Equipment Pool), it is possible for transport companies to clearly separate container assets from modal assets in order to improve efficiency (such as the turnover rate). For this, shipping companies use containers marked with the name of the company and offer availability capacity to its clients through its platforms.

Shipping companies have problems in TEU transfer logistics and container ships are affected in their routes, times and costs of transfers that generate delays due to nodal loading and unloading, inter-port, customs passages, however, the relocation of container ships on a port-to-port route increasing the transfer speed to more than 21 knots, which reduces the impact on the carbon footprint (Luo et al., 2021).

The repositioning of empty containers is at least 60 million each year. This repositioning of containers can occur on three scales: Local (they are queued before the recipient or consignor), Regional (intermodal repositioning or net exporter) and International (repositioning or net exporter). The costs of repositioning empty containers are multiple and include handling and transshipment at the terminal, positioning of the chassis for hauling, empty storage while waiting to be repositioned, inland repositioning by rail or truck to a terminal and marine repositioning (Ding et al., 2023 and Ng, 2024).

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Shipping companies spend, on average, $110 billion a year managing their container assets (purchase, maintenance, repairs), of which $16 billion goes to repositioning empty containers. This means that repositioning accounts for 15% of container asset operating costs. To cover these costs, shipping companies charge higher freight rates on the "full" leg and lower rates on the return leg.

These freight rate practices are therefore a major factor in shipping costs to developing countries in Africa, Asia and the Caribbean. The result is higher costs for imported goods, which has a detrimental economic impact when comparing consumer prices for the same product in different countries.

The repositioning of empty containers faces numerous challenges such as face the costs of access and storage in the terminals, wear and tear on equipment, downtime and loss of productivity of land transport fleets for access to doors in the return of empty containers and chassis. Of every 100 containers that enter the United States, 50% will be repositioned empty, the other 50% remain empty in the yards of port terminals and distribution centers waiting for export cargo to become available. Only around 5% of containers will be loaded with export products and the rest will remain on hold depending on supply and demand with container rotation and what this implies in the transfer out to sea and inland ports that function as a buffer yard. container ship (Cui et al., 2022).

The transshipment of containers with modern technologies helps repositioning according to asymmetries with respect to the loading plane of the container ship, repositioning, digitalization (location coordinates, temperature, humidity, pressure, geofences, impact detection, door opening and closing information), better level of control over the transport chain and alarms of theft, damage or violation of the integrity of the container.

Online freight exchange and virtual container yard platforms have been proposed to help connect different business needs where information on container availability is displayed, without the container needing to be in a physical storage warehouse, due to which may be in circulation or in a distribution center, but the important thing is that its availability is known for the logistical planning of the asset in supply chain management.

The main objectives of a platform organized by logistics companies external to shipping companies are to have information on assets such as containers, (characteristics, location, availability) road transport companies, shipping companies, distribution centers and equipment leasing companies. Global port logistics companies want shipping companies and ports to give up full rights to the use and management of their infrastructure so that they can carry out decision-making in the total management of the supply chain based on their administrative company as; transfer the lease agreement returns and exchanges of the container even without bringing the container back to the warehouse or terminal.

The reactions of maritime transport companies prefer those containers be within the maritime system, where they generate income for shipping companies, instead of being in inland ports where they generate income. for trucking, rail and barge companies. Because they are private companies with independent variable capital, for this reason international trade must be understood to be governed by several companies at a global level that, depending on their offshore assets and internal ports, occupy their leadership. These companies compete based on their market and infrastructure strategies; however, they are not a monopoly, therefore in a capitalist world they must compete among themselves for placement in the market (Ding et al., 2023).

Seasonality has a geography as harvest time varies between different regions of the world, which implies temporal and geographical fluctuations in the repositioning of empty containers. It is common in the agricultural sector for raw material prices to drop during the harvest season, but when actual production is finally known, uncertainties are eliminated. If production is higher than expected, prices fall, making containerization a less attractive alternative.

The average number of TEUs per hectare in yard or distribution center per year was 49,005 at container terminals. In North America there were 9,303 and in Hong Kong it exceeded 60,000 TEU per hectare per year. The productivity of port land has been achieved through planning, regulation and relocation.

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The relocation of urban ports is because they tend to be victims of the global success of their cities being reached by the urban sprawl; As cities become more attractive to investment, land values increase, making it difficult to maintain port functions in urban centers.

Every year around $20 billion is invested in repositioning empty containers. This amount implies that the Gross Domestic Product (GDP) of some countries is exceeded, which generates a red light for the global economy and an opportunity for other sectors. The average container spends 56% of its useful life inactive or empty, in ocean transit 16%, in terminal 16%, in land use 6% and in repair 6% (Efes, 2021).

Normally you can store a container in a port for five days for free, but if you exceed this limit, yard rental can cost $100 per day, depending on the shipping company and the port. This means that it is usually more profitable to move empty containers by means of a carrier to inland warehouses far from the ports where warehouse costs are lower and their return to load it, than storing them in port yards until they are shipped full (Ding et al., 2023).

Artificial Intelligence in container relocation

Some digital platforms have emerged as a proposed solution to the shortage of empty containers as a way of connecting carriers to carriers to ensure a frictionless procurement process for spot and contract purchases, completely online. This system automates complex tasks, provides unmatched visibility, and supports rapid data-driven decision making.

These companies were designed and built by logistics procurement experts, offering transparency, automation and efficiency to the global logistics industry. It is used and managed by some of the world's largest companies to respond to market volatility, control transportation costs and manage risk. However, these logistics companies depend on shipping companies, their infrastructure and services to be able to operate (Chen et al., 2024 and de Almeida Rodríguez et al., 2023).

The Shipping industry makes its operational logistics according to its infrastructure, business plan, area of operation and its reach through its commercial partners.

The business strategies of each shipping company depend on the logistics experience of its work team, and it may or may not use the technologies to carry it out. The incorporation of technologies (cloud business models, big data, blockchain, artificial intelligence, machine learning, mobile applications, etc.) (Raza et al., 2023 and Wang et al., 2023), on the part of the shipping companies will make logistics more friendly both for the company and for its users.

The implementation of cutting-edge technologies such as Artificial Intelligence, by Shipping Companies, can be seen as an opportunity for growth to the next level from where they currently are, and growth will be gradual. To do this, companies and their staff must follow procedures, acquisition and implementation of technologies in their workspace.

It is worth mentioning that the incorporation of Shipping Companies into artificial intelligence systems provided by external port logistics companies is not always attractive, because their business is a business at the level they are at, however, even at the next level the opportunities may vary depending on that what is a business under these conditions is a failed company on the other rung.

Shipping companies are not reluctant to cooperate as seen by the large global port logistics consortia, but rather they reserve their operating parameters in a continuous fight in competition as an integral company with its own assets in the face of the incorporation of global consortia. logistics companies that under agreements want to use their assets as their own, punishing prices in a world of global competition (Chen et al., 2024 and D'Amico et al., 2021).

Global Logistics Industries external to Shipping Companies, as indicated by global trends, want to have control and availability of assets through global negotiation where artificial intelligence can be a trigger for development in every sense, however for this it must be fed to the networks. of Artificial Intelligence in real time with data of different types involved in the port transport supply chain to be efficient.

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A complaint of his because problems such as the relocation of empty containers through global port logistics of Artificial Intelligence cannot be solved today is because there are limitations of global technological communication infrastructure, all global shipping and inland companies would have to merge to the generation of a shared logistics monopoly capable of sharing all assets and even profits (the dream of logistics and artificial intelligence), which in a capitalist system has no place, there will always be competition to offer transport services in the chains supply, therefore, companies can make, based on their assets, their network of subsidiary companies and a constantly expanding business strategy, an excellent competitor that shares classified information with their company, but will never do so with their competitors. The limitations of any management system, network or platform that can make decisions in real time requires the feeding of real data that is only shared between business groups for specific purposes, a limitation to the Idealization of Artificial Intelligence (Chen et al., 2024, D'Amico et al., 2021 and Zhao et al., 2024).

Results discussion

The availability of empty TEUs and FEUs is a global market that is governed by the laws of supply and demand depending on the region where they are required, therefore logistics companies open representation web portals to put the use of empty TEUs and FEUs up for sale. repositioned containers for rental or sale service for the transfer of merchandise, which does not mean that they monitor the container, their logistical activity for which they acquire their profits is mostly by representation and they leave the relocation under the discretion of the exporter, leaving the TEU sale or rental announcement published on its platform in case a new client requires the service, and the cycle begins again. Another way of using containers is under the form of cabotage with one-way leasing with real-time tracking that helps save money in repositioning.

A new form of repositioning is moving to collapsible containers. They offer the potential to save transport, transshipment and storage costs, but so far previous studies have shown that they are not an attractive proposition.

Although the economic advantages of folding containers seem obvious, these types of boxes must face commercial skepticism. This attitude refers to the technical performance, in particular the complexity of the folding and unfolding process, as well as the logistical and organizational problems related to the use of folding containers. (Lee & Moon, 2020).

Large deep-draft ships cannot be fully loaded with empty containers, due to the instability of the vessel's center of gravity, stacking and stowage. Shipping companies carry out container relocation as a port-to-port service with a charge of around $3,000 per empty TEU (folding or standard) by 2024, divided into the following services that include THC, port and terminal handling charges. Marine transport.

The total costs of the port-to-port chain of standard TEU relocation; deploy container, unload in warehouse, transport port – consignor (empty), transport consignor – port (full), THC (full), maritime transport (full), THC (full), port of transport – consignee (full), consignee transport – port (empty), receipt in warehouse, Folded container, discharge in warehouse, transport warehouse – terminal, THC (empty), sea transport (empty), THC (empty), transport terminal – warehouse, warehouse receipt, storage (empty) and operating costs (Kuhlemann et al., 2021 and Lee & Moon, 2020).

In the case of TEU relocation, container ships will seek to make the return trip North America - Asia profitable, but this requires that at least a third of the containers be full and for this the loading plan must be To maintain the stability of the vessel, place the full TEUs in the lower part of the ship's hull and also distributed throughout the bow (ship's cargo distribution planes).

The other 2/3 of the containers that the ship could load will be limited because the great heights of empty containers, even if they are braced, present instability, thus reducing the number of empty containers that are loaded onto the ship to only one third. giving a total of 2/3 of container filling on a ship that transports empty TEUs. Vessels with light cargo due to the transfer of 1/3 of empty TEUs increase the speed of around 20 to 25 knots, causing the vessels to experience greater instability and in the presence of empty containers in the highest part this can represent a problem. loss of containers due to tilt.

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On the other hand, filling this third of empty containers is not profitable in a port-to-port trip, but it will be even less feasible if we add to this that the ship makes stops between ports (for this there are intermodal services, trunk and transshipment of TEU collection to a larger port) and due to the dimensions of the draft, not all ports are suitable for calling, therefore, they will have to be loaded in ports that have the necessary infrastructure for yard storage, cabotage, relocation, and setting to carry out the operation (Li & Yang, 2023 and Li & Yang, 2024).

Some logistics companies offer free export services in the relocation of TEUs called cabotage, taking advantage of the bidirectional transfer of containers; however, this represents a market strategy for logistics companies to attract customers. These companies, through their portals, only generate communication and management to try to correlate importers and exporters (with representation expenses) in a process of sharing expenses in the handling, stay and transfer of containers, wanting to make pairs that can complement each other in the service.

On the other hand, months could go by and not find a commercial partner for bidirectional container transport purposes, which results in exporters ending up paying the costs of returning the TEU, to reuse it, as long as its stay in the yard and costs involved in repositioning they do not become more expensive than the manufacturing of the TEU, otherwise companies tend to ignore their own containers, generating waste pollution in the importing country.

So that this does not happen and the TEU is used at least six times as a means of transportation and is profitable, the logistics company, the shipping companies and the client should have the TEUs that will be used in their exports in continuous movement, thus generating lower costs. the relocation of TEUs until the end of their useful life (de Almeida Rodríguez et al., 2023).

On the other hand, if companies in the maritime sector do not want to reposition TEUs that can be useful to the company, they will even less do so with containers that have reached the end of their useful life.

For this reason, they ignore containers, generating a large amount of waste that accumulates in port yards and private warehouses on land, but the companies in charge of administration cannot use or dispose of TEUs because they are from international companies. that control the assets of the ports and therefore all the abandoned TEUs are viewed as private property of the shipping companies that they must respect in the hope that at some point they will want to be responsible for the yard storage costs that these TEUs caused, although that never happens. happens.

Coupled with a lack of regulation, status, membership, characteristics sheets updated by shippers in the yard, unfinished port procedures, legal disputes between freight forwarders and container owners, it means that shipping companies, ports and owners can go unnoticed of their responsibility.

On the other hand, external logistics companies play an important role in monitoring containers, being the most suitable to clarify the particular cases of each TEU and although it is true that they are only part of the supply chain and there are many companies similar to them When each TEU arrives at its companies, it has a very complete file that allows the specific case of each container to be tracked (that is why before lowering the containers, the port captain together with his fleet verifies documentation).

Most logistics companies say no. have monitoring or internal classified information, so they do not share it, playing a role of loyalty and service to shipping companies due to the fear of losing contracts. Therefore, the relocation of TEUs and their circular economy are limited to commercial interests and between companies (D'Amico et al., 2021 and de Mattos Nascimento et al., 2024).

Lower freight rates for the return trip. Export products from developing countries are generally of lower value and it is often too expensive for them to ship their products in containers, as this will increase the price of the products by a large percentage and the competitiveness of product placement. regional in the global market is limited by social cultural factors, uses and customs and above all that the manufacturers are retailers who in most cases do not fill the volume of a TEU unit, which implies that producer cooperatives are generated.

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However, if they are offered a lower shipping rate, the container option could become attractive as they are subsidized with a portion of the freight cost by their country's governments.

Online sales increasingly bring the user closer to virtual logistics platforms for shipping containers of products and their return, making users track container transshipments, but the lack of knowledge of the real system and including A sequence of times and customs procedures when the smallest details are unknown generate unforeseen events and delays that must be resolved remotely and with language barriers, making tracking complex until the shipment is lost, which affects the relocation of the TEU. It is recommended that as a user you hire an expert logistics agent for the container tracking process, and this will avoid financial losses and headaches.

Conclusions

The relocation of empty dry TEU, FEU and Refrigerated containers on the Transpacific and Transatlantic routes is due to the imbalance between imports and exports. Maritime commerce is evolving in all its parameters, making online purchases through platforms increasingly easier. China has created a privileged position among the exporting powers; however, it must also face the problem of container shortages, causing the shortage to put the global market at risk, which is why it has been involved in the relocation of containers.

Different methods and proposals have been used for the relocation of empty TEUs, which involve techniques by port operating personnel, logistics experts through iterative platforms, application of information technologies ranging from spreadsheets to artificial intelligence, proposals technological folding containers, and a whole brainstorm of ideas to solve the problem. However, the limitations to these technologies, methods and strategies are that shipping companies, logistics companies that assist shipping companies, and private entrepreneurs are competition and although the market for shipping companies is small, because there are large Consortiums that dominate the market all compete for customer satisfaction and private enterprise prosperity in unique ways.

The data sharing barrier is a limitation in artificial intelligence networks, coupled with the lack of a bidirectional export market on the route, so the few exporters that may exist from the Americas to China are limited and sought after. unstoppable way for the shipping companies. On the other hand, the balance of the price of dry TEU and FEU in new base form with respect to the relocation costs in optimal conditions of transportation without delays and storage of containers in port service yards, in addition to the lack of commitment on the part of shipping companies, ports, businessmen and governments that do not agree on generating strict regulations for the container problem are the perfect mix to indicate that they are working on it but not to resolve in accordance with applicable international laws, which regulate the large number of containers abandoned to their fate in importing countries.

However, the relocation of refrigerated containers, even if they travel empty, is a priority for the different sectors of international trade, due to their high manufacturing and technology costs, but this is not the case for base containers that do not generate profits or, worse yet, economic losses. Moreover, this lack of regulation, combined with port administrative problems, undocumented goods and owners who claim possession of abandoned containers in importing countries, represent factors that influence the relocation of containers in a lack of commitment to a sustainable circular economy, consequently this puts the global market at risk.

Because there are no specific international laws that oblige the exporter to take care of their waste, although events such as agendas and summits are held to solve the problem, they are only social events between nations that evade and prolong the problems and a strategy that has been successful for them. We are working on it while the destruction of the planet increases without being aware of the problem.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

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Authors' Contribution

Flores-Cruz, Luis Antonio: Contributed to the project idea, research method and technique, about to develop all the project.

Cruz-Gómez, Marco Antonio: He supported the design of the field instrument. He also contributed to the writing of the article.

Lara-Andrade, María Verónica Altagracia: Contributed to the research design, the type of research, the approach, the method and the writing of the article.

Vázquez-Juarez, Patricia: Resarched multiple papers and information about the topic.

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Abbreviations

FEU	Forty-foot Equivalent Unit
GDP	Gross Domestic Product
ISO	International Organization for Standardization
TEU	Twenty-foot Equivalent Unit
THC	Terminal Handling Charges

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