School of Social Sciences

Postgraduate Course in Supply Chain Management

Postgraduate Dissertation

New technologies in the transport sector to promote
international trade

Maria Chatziefraimidou

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"Dedicated to my mother, who has always encouraged me to keep moving forward to become the best version of myself".

Abstract

To begin with, this essay starts with an overview of the effects of globalization on international trade. It discusses how globalization has impacted the transport industry and made moving goods and services across borders easier. In addition, it examines the effects of globalization on transport sectors, such as increased efficiency, accessibility, and cost-effectiveness.

With the passage of time and the emergence of cutting-edge technologies has come a revolution in how organizations conduct international trade. In particular, transport systems have experienced tremendous technological advances that have led to the availability of innovative and more efficient transport options. This essay examines various new technologies used in road, air and sea transport to promote global trade. It examines the impact of technologies such as autonomous vehicles, drones and blockchain on commercial industries to demonstrate their potential to improve efficiency, safety and reduce costs. In addition, this essay explores the challenges associated with adopting new technologies and any opportunities they present for international trade.

The research findings demonstrate how integrating such new technologies into transport industries could significantly enhance global economic growth and bring tangible benefits in increased international trade and economic expansion.

Keywords

International trade, new technologies, artificial intelligence, blockchain, transportation

Περίληψη

Αρχικά, το δοκίμιο αυτό ξεκινά με μια επισκόπηση των επιπτώσεων της παγκοσμιοποίησης στο διεθνές εμπόριο. Συζητείται πώς η παγκοσμιοποίηση είχε επίδραση στον κλάδο των μεταφορών και έκανε ευκολότερη τη διακίνηση αγαθών και υπηρεσιών πέρα από τα σύνορα. Επιπλέον, εξετάζει τις επιπτώσεις της παγκοσμιοποίησης στους τομείς των μεταφορών, όπως η αυξημένη αποτελεσματικότητα, η προσβασιμότητα και η αποδοτικότητα του κόστους.

Με το πέρασμα του χρόνου και την εμφάνιση των τεχνολογιών αιχμής έχει έρθει επανάσταση στον τρόπο με τον οποίο οι οργανισμοί διεξάγουν το διεθνές εμπόριο. Ειδικότερα, τα συστήματα μεταφορών γνώρισαν τεράστια τεχνολογική πρόοδο που οδήγησε στη διαθεσιμότητα καινοτόμων και πιο αποτελεσματικών επιλογών μεταφοράς. Αυτό το δοκίμιο εξετάζει διάφορες νέες τεχνολογίες που χρησιμοποιούνται στις οδικές, τις εναέριες και τις θαλάσσιες μεταφορές για την προώθηση του παγκόσμιου εμπορίου. Εξετάζει τον αντίκτυπο τεχνολογιών όπως τα αυτόνομα οχήματα, τα μη επανδρωμένα αεροσκάφη και η αλυσίδα μπλοκ (blockchain) στις εμπορικές βιομηχανίες για να καταδείξει τις δυνατότητές τους να βελτιώσουν την αποτελεσματικότητα, την ασφάλεια και να μειώσουν το κόστος. Επιπλέον, το δοκίμιο αυτό διερευνά τόσο τις προκλήσεις που συνδέονται με την υιοθέτηση των νέων τεχνολογιών όσο και τις τυχόν ευκαιρίες που παρουσιάζουν για το διεθνές εμπόριο.

Τα ευρήματα της έρευνας καταδεικνύουν πώς η ενσωμάτωση τέτοιων νέων τεχνολογιών στις βιομηχανίες μεταφορών θα μπορούσε να ενισχύσει σημαντικά την παγκόσμια οικονομική ανάπτυξη και να οδηγήσει σε απτά οφέλη όσον αφορά την αύξηση του διεθνούς εμπορίου και την οικονομική επέκταση.

Λέξεις κλειδιά

Διεθνές εμπόριο, νέες τεχνολογίες, τεχνητή νοημοσύνη, blockchain, μεταφορές

List of Abbreviations & Acronyms

AI: Artificial Intelligence

AR: Augmented reality

C-ART: Connected Automated Road Transport

FDI: foreign direct investments

IoT: Internet-of-Things

Maas: Mobility as a Service

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Introduction

The transport sector is one of the main pillars of global trade growth. Globalization, in which states and companies began to operate across the world map, triggered a feverish development in world trade.

New technologies such as automation, digitized information flows, and AI provide many opportunities for the development of the global economy. opportunities to improve efficiency, reduce costs and increase service levels in the freight sector. Indeed, digitization can radically change how business is done and improve the quality of services.

The literature examines opinions on new technologies, while an attempt is made to investigate the positive and negative impacts of achieving a sustainable transport system. This essay focuses on three primary talking points: implementing hyperloop transportation systems, reducing transit costs and time-frames, and improving logistics and supply chain management practices. It highlights why these aspects are crucial in promoting international trade using innovative transport technologies. In summary, this work examines how new tech-based solutions could transform traditional models in global commerce while considering their sustainability impacts worldwide. Our findings will be valuable for businesses and policymakers looking to advance sustainable economic development goals through technological innovation.

Chapters one and two analyze the phenomenon of globalization and its evolution over time and how it has affected the international trade sector. The factors affecting international trade are technological and policy advances, lower transport and communication costs, and increased dependence on market influences.

Chapters four and five analyze technological developments in the transport sector have significantly impacted international trade. Road, sea , and air transport innovations have made transporting goods across borders easier, faster, and more cost-effective. These advancements have also brought new challenges and threats to the global trade ecosystem. This is particularly evident within international trade, where development of road transport has played a crucial role in expanding networks, improving roads and , upgrading road infrastructure systems.

Chapter six is referring to vehicle innovations have greatly simplified goods transport over short distances. Trucks and vans, in particular, make this easier by making intercontinental

deliveries possible, helping businesses expand into new markets more quickly. Although road transport has made logistics simpler, there are significant obstacles. Truck and van emissions remain an increasingly pressing concern and governments and businesses are exploring strategies to limit the environmental effects caused by diesel vehicles. Transport costs are another challenge, with fuel being the determining factor of transportation costs.

Meanwhile in chapter seven, sea transportation has long been part of international commerce; thanks to technological advancements in shipbuilding techniques more ships than ever can operate worldwide. Massive container ships have provided a more effective means of moving more goods over longer distances at lower costs and increased trade between countries and continents by decreasing transportation costs and increasing the volume of goods transported. New models continue to emerge for this important task. Piracy has emerged in response to advancements in sea transport, leading to private security firms being deployed on ships for the added transport cost and raising concerns over maritime security. Shipping generates significant pollution. Air transport has transformed international trade through advances in its design and manufacture; now allowing planes to transport goods faster.

After, in chapter eight airlines have revolutionized global trade by rapidly transporting perishable goods quickly and relatively cheaply over great distances, cutting lead times significantly in international trade. Yet air transport also comes with its own set of risks. Air transportation presents unique challenges. It tends to be more expensive than other forms of transport, making it less attractive for many businesses and governments worldwide. Furthermore, its carbon emissions continue to be an increasing source of concern.

In chapter nine, using his indexes, Sussman (2000) provides insights into their impact on international trade, providing evidence of their future impact and influence. With extensive analysis, Sussman (2000) clearly illustrates this point. These technologies have significant implications for traditional businesses and emerging markets, from blockchain to artificial intelligence. This essay investigates these transformational innovations impacting how we do things and the lives of people around us.

After our essay assess how technological innovations in transport have fundamentally altered business operations and our understanding of what it means to be global citizens.

Decision-making and supply chain optimization has undergone dramatic transformations over the years, opening the way for autonomous cargo-tracking drones that promise to revolutionize international trade. Their deployment would create opportunities to increase efficiency in

logistics management. Digital transformation provides many advantages for organizations, including increased efficiencies, greater logistics operation visibility, cost-cutting opportunities and sustainable development. Furthermore, the rise of digital trade platforms has become essential to international businesses for improving efficiency and transparency.

Such platforms provide businesses with a centralized location for communication and data management, reducing the costs of traditional international business methods. It is worth mentioning that the successful implementation of these transformative technologies requires collaboration and investment from both private and public entities. These game-changing technologies have reduced paperwork and delays at ports of entry while increasing security measures in mobile applications for trade transactions, ultimately revolutionizing global commerce.

Methodology

The methodology followed for the following paper involves analyzing various educational articles related to new technologies in the transport sector and their potential impact on international trade. Sources were selected based on their relevance, reliability, and credibility as scholarly works. Search engines and academic databases were utilized for this research to locate relevant articles. Keywords used included "new technologies," "transport," and "international trade." After finding several articles that fulfilled the criteria, further examination was performed.

Critical reading techniques were utilized in the below analysis, including summarizing main points, contrasting opposing viewpoints, evaluating the evidence presented by authors and drawing conclusions about relevance. Educational articles provided additional background for further exploration. Sources were chosen based on their relevance to the topic and credibility in academic circles, while research involved carefully reading each article, taking notes of key points, and collecting pertinent data.

Once this data had been collected, an analysis was performed to identify common themes and patterns among these sources - providing a thorough insight into both benefits and challenges associated with connected vehicles in China. Due to its complexity, using multiple sources was vital in creating a comprehensive overview. Education articles were beneficial as sources; experts provided insights and ensured accuracy throughout.

Specifically, Sussman (2000) conducted this analysis as part of their research process to understand how technology can promote international trade in transport by exploring both positive and negative effects. Alongside his literature review, Sussman (2000) conducts case studies to supplement his findings. These case etudes explore the practical ramifications of new technologies on international trade. By identifying specific technological innovations that have altered trade patterns and examining how their mechanisms operate, case analyses seek to explore their possible effects on trade patterns.

Sussman (2000) investigates various events that have transpired; for instance, she examines e-commerce platforms' effects on cross-border trade or blockchain technology's role in international payments or uses multiple data analysis tools to quantify them.

He gathers and analyzes data on global trade flows, tariffs and other relevant factors before using statistical techniques to detect correlations and trends. Additionally, he used simulation models to simulate different outcomes for various policy options. His methodology for studying how new technologies might influence international trade was highly multidisciplinary, drawing from insights across fields. To this end, Sussman (2000) draws upon economics, business and computer science techniques for his research methods to gain an in-depth knowledge of how global commerce uses technology. By using various research methodologies she can thoroughly examine the relationship between technology and international commerce. Her study encompasses globalization as a source of internationaltrade vs accidental trade as a central theme.

1. Globalization and international trade

Based on a historical perspective, international trade has grown remarkably in recent centuries. Global trade's history records remarkable events that have affected trade between countries. Before the rise of the nation-state, the term "international" trade could not be applied literally, but it meant long-distance business (Langer, 1968). After a long period characterized by persistently low international trade, during the 19th century, technological developments brewed up a period of remarkable growth in world trade. This was the first wave of globalization.

This growth process stalled and eventually reversed in the interwar period. However, since World War II onwards, international trade began to grow again, and in recent decades, the expansion of commerce has been faster than ever before. Today, exports and imports across all

nations exceed 50% of the world's output. At the beginning of the 19th century, this figure was below 10% (Ortiz-Ospina, 2018). The global expansion of trade after World War II was largely possible due to a reduction in transaction costs resulting from technological developments such as the development of commercial and civil aviation, improved productivity in commercial shipping, and the development of the telephone as the primary mode of communication. Two obvious reasons are technology and politics. Additionally, improvements in both transportation and communication sectors have increased globalization in all markets, trends that are now accelerated by the Internet. Although, policies have changed direction over the years, limiting international transactions and mobility after World War I and expanding them after World War II (Deardorff, 2022).

The "first wave of globalization" was characterized by intersectoral trade. This means that countries exported products differently from those imported (England traded machines for Australian wool and Indian tea). This changed in the 'second wave of globalization.' Intra-industry trade (i.e., the exchange of broadly similar goods and services) increased significantly after the Second World War - (France now imports and exports cars to and from Germany). In the 21st century, China, the European Union, and the United States are the three most significant trading partners in the world markets.

Globalization is a dynamic process driven by technological change and carried out through clearly defined international channels: free trade in goods and services, free flows of goods and services, free flows of free movement of capital, and movement of people. According to Martin Wolf (2005), globalization is the integration of economic activities through markets. The driving forces are technological and political changes - reducing the cost of transport and communications and greater dependence on market forces. Dani Rodrick (2011) argues the above statement, claiming that globalization can potentially limit democracy. Global markets, sovereign states, and democracy cannot coexist. Thus, globalization is a natural political phenomenon with its distribution in different phases and then links these phases to the evolution of the international monetary system. This approach allows the separation of globalization into different degrees of fundamental and financial integration, different rules on the convertibility of currencies, the nature of the exchange rate regime, the definition of the reserve base, the meaning of the currency reserve, and so on. Thus, by choosing this approach, the concepts of 'globalization' and the 'international monetary system' are strictly linked.

2. The transport sector and international trade

Transport is the cornerstone of international trade. The technological progress in the transport sector since the beginning of the last century is inextricably linked to the growth rate of international business and the volume of goods traded worldwide (Hummels, 2007). The transport sector enables any productive entity to make its products and raw materials available in any direction. The purpose of transport in the future is the annihilation of distances and the cheapest possible transport of goods as cheaply as possible. The long period of peace combined with technological evolution has resulted in developing a more efficient transport sector and creating of infrastructures that serve more efficient and cost-effective ways of moving goods. The distribution of goods, from the point of production to the end of consumption, has lived and lives, over the years, a development in parallel with the development of technology in transport and distribution centers.

Transport is divided into sea, road, rail, and air transport, and the choice is based on the individual characteristics of the goods transported. Alongside carriers, the development of logistics is helping to reduce the transport cost. The cost and time needed to transport goods from one place to another (Pierre, 2015).

3. The contribution of the transport sector and international trade to economic development

The modern world is characterized by increased globalization, which has been made possible by developing transport infrastructure and international trade. The contribution of these two factors to economic development must be considered. Countries that have invested heavily in transport infrastructure and embraced international trade have witnessed tremendous economic growth.

Transportation is crucial in facilitating the movement of goods, services, and people across geographical borders. It enables businesses to access raw materials and markets for their products. Additionally, it creates employment opportunities for people who work directly or indirectly within the sector. The transportation industry also drives economic growth through investment in new technologies that enhance efficiency.

International trade involves the exchange of goods and services between countries with different comparative advantages. This leads to specialization among nations where each country focuses on producing what they can deliver most efficiently while importing what they need from other countries at lower costs than would otherwise be possible if each nation were self-sufficient. International trade exposes countries to new ideas, cultures, technologies, and foreign direct investments (FDI). FDI stimulates economic activity by providing capital for businesses that can create jobs while driving up competition leading to innovation.

AREA	DESCRIPTION	BROAD INNOVATION	IMPACT
INPUTS / RAW MATERIAL	Done at farm or factory	• Automation • Remote monitoring • Analytics	• Improves yield • Less waste • Informed planning based on weather patterns and soil quality
FACTORY	Additional processing	• Robotics • Additive manufacturing • Artificial intelligence • Internet of Things • Digital Twins	• Efficiency in speed with fewer errors • Reduced waste, less tools and can produce complex parts • Faster decision-making with a smaller margin for error and optimized production processes • Increased productivity, fewer unplanned breakdowns and safer prototypes ,testing new products inexpensively and faster introduction to market
FIRST MILE	Transportation in larger quantities (maritime and land transport)	• Electrification • Internet of Things • Hyperloop • Blockchain • Artificial intelligence • Platooning (Trucks) • AR/VR • LCL Gap filling	• Decarbonization and lower GHG emissions • Seamless connection to improve communication between multiple modes • Increase in speed • Reduces risk of fraud, speeds up approval processes and digitizes / secures documents • Fewer accidents and optimized route planning • Efficiency in fuel consumption • Training in simulated environment would free up delivery vehicles • Solutions to optimize container capacity
PORT	Port operations	• Simulation based training • Internet of Things • Automation • Augmented Reality • Digital Twins	• Less risk of damaging equipment • Monitoring pollution, water noise and vehicular movement in the port • Less human error as automation would improve efficiency in operations • Used in navigation systems causing lesser accidents, offer visual support for ship operations • Help ports cut emissions, improve safety processes and effective sharing of data
MIDDLE MILE	Warehouse	• RFID / wearables • Robotics / Automation • Internet of Things • Autonomous vehicles • 3D Printing	• Monitoring packages and pallets • Autonomous systems allow for defined processes to be handled by systems with zero human error • Tracking vehicles and ensuring upkeep so that downtimes can be predicted • More safety for humans and can provide more efficiency in warehouse operations • Lower production of spare parts at decentralized locations to respond to customer complaints
LAST MILE	Transportation in smaller quantities	• Electrification • Drones • Artificial intelligence • Gigification • Microhubs	• Decarbonization and lower GHG emissions • Speed and efficiency in delivery • Optimized route planning • New emerging business models allowing gig workers to 'uberify' package delivery • Allows for same day delivery

Source: Lucidity Insights Research

Figure 1: https://www.entrepreneur.com/en-ae/growth-strategies/how-technology-affects-international-trade/443071

The transport sector and international trade play a crucial role in the economic development of a country by facilitating the movement of goods, services, and people, creating employment opportunities, and driving economic growth along with globalization; both aspects will be explored thoroughly throughout this piece showcasing why these sectors should continue being prioritized moving forward as part vital components responsible for propelling any economy forward into sustainable growth patterns over time.

The transport sector is a critical component of economic development in any country. It plays a pivotal role in facilitating the movement of goods, services, and people from one place to another. According to "Transport Investment and regional development" (2016), transportation infrastructure investments can enhance regional connectivity by reducing travel time and distance between markets. Additionally, it creates employment opportunities for people working in transportation-related fields. International trade is also vital for economic growth as it allows countries to access new markets and increase their competitiveness on the global stage.

However, high transport costs can significantly hinder trade liberalization efforts (World Trade Organization, 2004). This issue becomes more pronounced when dealing with agricultural or mining products that are typically more costly to ship than manufactured ones. Developing countries often face higher transaction costs due to logistical challenges related to transportation modes such as maritime, air, and road transport (CARANA Corporation, 2003). As noted in CARANA's article about logistics being crucial in international trade, especially when considering developing nations like those found across Sub-Saharan Africa where infrastructure remains insufficiently developed compared with advanced economies, which makes them less competitive through barriers such as tariff rates imposed upon their exports, making them uncompetitive against cheaper imports dominating local markets.

Despite these challenges associated with the transport sector and international trade, there are still growth opportunities, particularly those linked with globalization trends fueled by technological advancements allowing businesses around the world greater access to other regions creating new business models based on virtual exchange rather than traditional physical routes over the land sea or airways systems that have been used thus far. In conclusion, then we should consider how improving our logistical capabilities could lead towards increasing prosperity globally while simultaneously unlocking untapped potential domestically, all while minimizing negative environmental impacts associated with carbon emissions generated by

current modes of transportation throughout supply chains spanning both production consumption phases involved international commerce today underpinning much social progress worldwide currently reliant upon continuous innovation incorporating clean technologies better aligned sustainably with the planet than industrial processes used in the past.

The transport sector and international trade are two critical components that drive economic development in a country. These sectors facilitate the movement of goods, services, and people, creating employment opportunities while contributing to economic growth and globalization. One interpretation of this thesis statement is that infrastructure facilitates trade and transportation. The construction of roads, bridges, railways, ports, airports,s and other modes of transportation reduces transaction costs by making it easier for businesses to move their goods across borders (Katrakylidis et al., 2019). Moreover, investments in technology have allowed for more efficient shipping methods through automation, bringing down transport costs even further. A second interpretation could be that the contribution of these sectors extends beyond just reducing transaction costs; they also create job opportunities and stimulate demand for products produced domestically or abroad. This is because increased connectivity between nations enhances competition among firms leading to innovation while driving up productivity levels due to specialization.

Governments should prioritize investment in infrastructure projects such as improving ports or new highways since these initiatives will lead directly towards growing exports, ultimately contributing to economic development goals. Future research should focus on exploring how industries are affected by changes in global markets due to either internal factors, such as technological advancements, or external ones, like political instability. Additionally, research into what types of jobs are being created within different countries' economies would shed light on whether there exists a need for more significant investment into skills training programs so workers can acquire the necessary skills required by a changing labor market. Overall, it is clear that both the transport sector and international trade play essential roles when looking at how countries develop economically speaking - but understanding exactly how each contributes requires work examining factors like infrastructure capacity constraints alongside industry-specific demands over time.

In conclusion, the transport sector and international trade have significantly contributed to economic development through various means, such as enhancing market accessibility,

increasing competitiveness, creating employment opportunities, and facilitating technology transfer. The interdependence between these two sectors has positively influenced economic growth by promoting investments in infrastructure development and diversification of production. The transport sector's contribution and international trade cannot be overstated when boosting financial performance worldwide. With this understanding firmly entrenched within national development strategies worldwide, there are prospects for continued progress toward inclusive prosperity globally.

4. The role of technologies related to intermodalism and the promotion of intermodal transportation

Intermodal transportation is an integral component of the global trade ecosystem. Intermodalism entails simultaneously using different modes of transport - ships, trains and trucks - to maximize efficiency. Recent years have increased interest in intermodalism technologies that could revolutionize freight movement between regions. Working together, trucks, airplanes, and ships make up an interconnected system to promote efficient and environmentally responsible freight movement.

Autonomous vehicles and drones have emerged as transformative technologies with the potential to transform intermodal logistics dramatically. We will explore three key points regarding these innovations' effects: speed enhancement for faster delivery times; cost reduction through automation; and environmental sustainability through reduced carbon emissions. As technology quickly progresses, its influence on industries like logistics requires careful evaluation. By integrating cutting-edge tools into existing infrastructure, companies can realize immense advantages while strengthening supply chain resilience.

Implementation of advanced tracking technologies has the power to revolutionize intermodal transportation by improving efficiency and reliability. With such technology in place, intermodal logistics could see a significant transformation. Donovan writes of seamless coordination among various transport modes as essential to effectively move goods over long distances. He states in his article, that such coordination allows goods to move smoothly across vast expanses.

According to "Comparative Aspects of Transport Systems (2017)," trailer-sized containers debuted as intermodal transportation tools during the 1960s. This was an essential step forward

in its evolution. Containers became popular by standardizing freight boxes for surface freight transportation in the 1970s. By the turn of the century, 95% of cargo moving across continents was carried in containers (Donovan 2017). With such high volumes being shipped across long distances, advanced tracking technologies are necessary to ensure that shipments arrive on time and in good condition. Intermodal transportation requires enormous coordination between various parties, such as shippers, carriers, and logistics companies, which sometimes makes it challenging. Nevertheless, with highly efficient tracking systems that provide real-time data on shipment locations along with detailed information about container conditions, including temperature control systems within them, this process becomes more accessible than ever before.

Furthermore, these sophisticated monitoring systems significantly reduce incidences where products get lost or damaged during transit resulting in higher customer satisfaction levels while reducing operational expenses associated with inefficient operations (Donovan,2017). At this end, implementing advanced tracking technologies is fundamental to optimizing intermodal shipping networks' effectiveness from operational efficiency perspectives and ensuring customers receive their orders without hiccups.

The intermodal supply chain has experienced a significant transformation in recent years by integrating digital platforms and applications. According to Dempsey (2000), these technologies have facilitated information and resource sharing among stakeholders, promoting greater collaboration, enhancing efficiency, and reducing costs. Indeed, digital platforms such as e-commerce marketplaces and cloud-based logistics systems can enable real-time tracking of shipments across various modes of transportation. Additionally, mobile communication apps provide instant communication between suppliers, carriers, and customers on delivery status updates or other issues that may arise during transportation. Dempsey (2000) observed that this surge in foreign trade could be traced back to transport restrictions being removed, leading to an examination of legal frameworks related to transportation policy. Tools have revolutionized global distribution channels for goods, allowing businesses to increase trade.

Timely alerts of shipment milestones and insights into potential bottlenecks within their supply chains that might disrupt delivery are two benefits that technological innovations such as digital platforms and applications can bring. Overall, adopting technical solutions provides immense advantages to all stakeholders involved with international trade operations through increased visibility leading to cost savings that directly benefit organizations' bottom-line margins.

Transportation industry executives have sought ways to simultaneously decrease costs, enhance efficiency, and minimize environmental impacts. According to Allen (1992), autonomous vehicle/drone technologies hold promise as solutions that could simultaneously revolutionize intermodal transport by meeting all three goals. According to this source: "the introduction of autonomous vehicles/drones may transform intermodal transportation by increasing its safety."

Freight transport companies need to focus on speed, cost savings and environmental sustainability when setting prices for freight transportation services. This technology can ensure faster delivery times while decreasing fuel consumption through optimized routing techniques and improving safety by eliminating human driving errors or piloting duties. Unfortunately, such a transition necessitates considerable cost and disruption.

Infrastructure development for charging stations or landing pads and regulatory frameworks that ensure their safe operation require significant investments and efforts to complete. Furthermore, their safe operation must comply with specific guidelines set by regulatory frameworks that guarantee the safe operations of these structures. There is an increasing need for workforce training programs that equip professionals to operate and maintain these emerging technologies effectively. Integrating autonomous vehicles and drones into intermodal transportation systems could bring many advantages; however their fullest potential to bis e realized.

Technologies associated with intermodalism and its promotion should be considered necessary for freight transportation. Through technological innovation, efficiency has improved exponentially while sustainability levels in freight industry operations have seen vast improvements due to advances in intermodulation technology. As with any new development or innovation, concerns and hurdles still need to be overcome; autonomous vehicles and drones have demonstrated this point well.

These cutting-edge technologies promise to transform intermodal transportation by increasing speed, decreasing costs, and reducing environmental impacts. Their implementation responsibly could revolutionize supply chain logistics as we know it today. Solutions must also be found for infrastructure limitations such as inadequate roadways or electric truck charging stations to create the optimal environment for society. As individuals and members of community alike, we should continuously seek improvements. One approach to meeting these objectives is investing in research and developing intermodal transportation technologies. With

ongoing investments into R&D comes increased improvements that lead to promising future possibilities in intermodal transport technology, improving intermodal mobility even further.

5. Technologies in the transport sector

5.1. Blockchain technology

Blockchain was conceptualized through Satoshi Nakamoto's seminal 2008 article "Bitcoin: A Peer-to-Peer Electronic Cash System," posted to a cryptography mailing group mailing list under this pseudonym. From an engineering point of view, Blockchain stands apart.

At its core, blockchain can be defined as an untrustworthy global system using chronological encrypted blockchain data to store verifiable and synchronized information over peer-to-peer (P2P) networks. Blockchain offers both security and independence while operating as any decentralized structure would. Lagin et al. 2020) describe blockchain as an open distributed computing model which uses distributed consensus algorithms, encrypted blockchain storage technology and unexecuted scripts (Elagin et al. 2020). Because of these unique properties, blockchain has become the basis of many cryptocurrencies, including Ethereum (ETH).

Bitcoin has quickly become one of the first and most successful "killer use cases". From one perspective, blockchain can be seen as a decentralized universal system which uses encrypted chronological blockchain data to store verifiable and synchronized information over peer-to-peer networks. Blockchain represents new decentralized architecture and technology development for verification processes on these networks.

Distributed computing models utilize distributed consensus algorithms and encrypted blockchain storage technology for creating, storing, and handling information. Unexecuted program handles any unmet tasks regarding taking this information.

Blockchain has emerged as an indispensable component of several cryptocurrencies, with Bitcoin serving as its "killer use case". The basic premise of all the blockchain systems is the same, with slight variations in the consensus mechanisms. Typically, blockchain data is stored in each node participating in a decentralized P2P network which will be verified and recorded on the blockchain using the consensus mechanism. For example, Bitcoin uses the Proof-of-Work mechanism (e.g., mining) with distributed nodes contributing their computing power to compete in a mathematical puzzle with dynamically adapted difficulties. The node that successfully solves the puzzle wins the right to pack all transaction data in a given period into

a new block and add them to the main blockchain. The winning node will automatically reward and reward a certain number of coins. This process is then repeated, with each node starting to solve a new puzzle. The blockchain data will be hashed and encrypted for security (Koh et al., 2020). Smart contracts that are "self-executing" or automated computer code remain unchanged within a blockchain and perform specific actions when certain conditions are met (Balasubramaniam et al., 2020).

These actions could be deterministic terms and execution of a natural language contract, i.e., commercial activities. Similarly, they could be any conditional actions or procedures that blockchain members wish to automate. Smart contracts can be linked to a traditional natural language contract or operate independently to automate steps (Li et al., 2019). For example, the intelligent code contract could indicate that a wholesale manufacturing company will pay automatically pay the freight forwarder $500 the moment it is received a particular shipment at the port of Southampton (Pournader et al., 2020).

The smart contract is contained in a blockchain. A consensus validation is performed when the information confirms that the specific shipment has been received and is added to the blockchain. The money is transferred (Oham et al., 2018). The idea of smart contracts is familiar, having first appeared in 1996. Blockchain is the "jet fuel" necessary to make intelligent contracts friendly. The prospect is that physical contract language will be equivalent or replaced entirely by code (Elaginet al, 2020).

Distributed databases, where data is replicated and stored on different machines, already exist. Oracle released a system-distributed database in 1985. Where the blockchain differs is that the database management is centralized uniquely. There are also centralized databases where data is kept on storage devices connected to a single machine (Koph et al., 2020).

The three main activities performed in databases are:

- Reading
- Writing
- Validation (Balasubramaniam et al, 2020).

In centralized distributed databases, reading, writing, and validation activities are controlled by one entity. Read access can be given to different stakeholders. In a blockchain, all three actions are performed and directed by stakeholders in a network, and the information is only written

when other stakeholders validate it. This increases trust in the data held in the database; and enables de-mediation (Li et al., 2019).
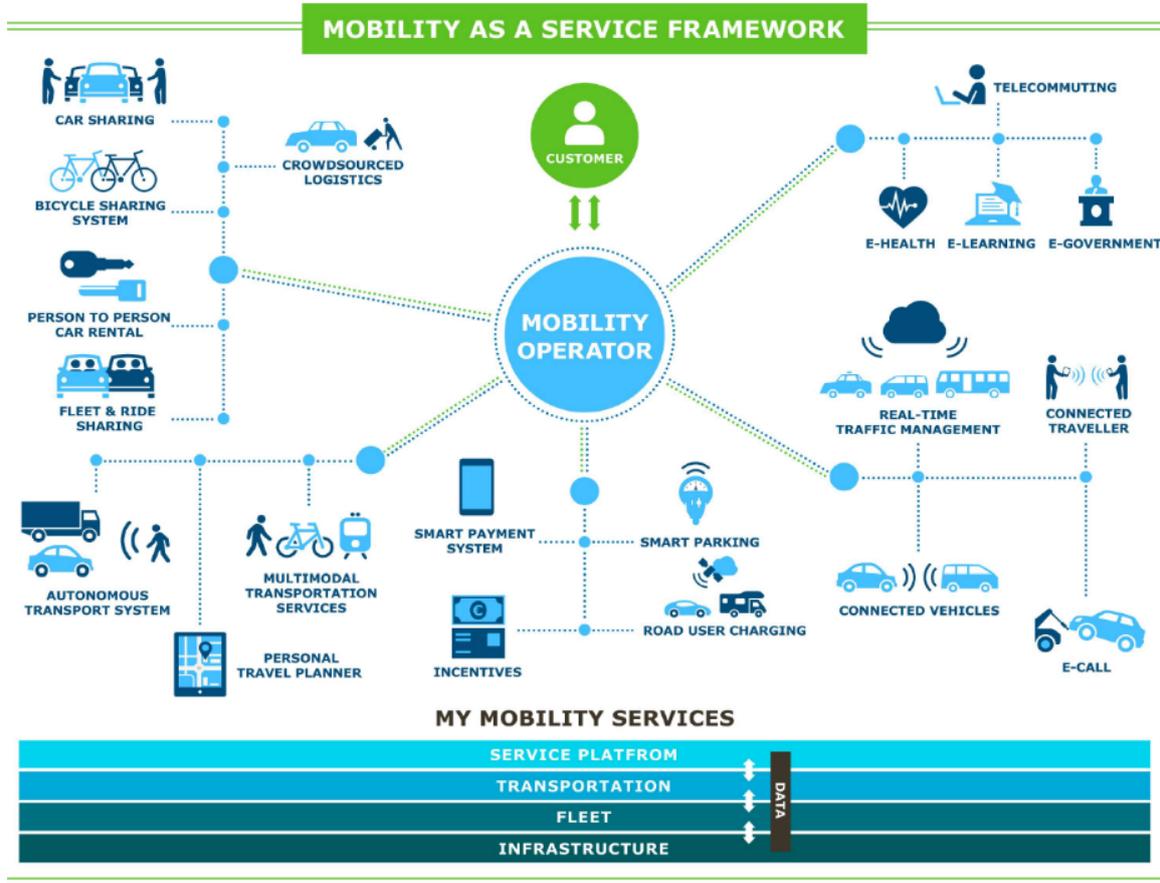
Mobility as a Service (MaaS) is a new business model that attracts the transport sector and can change journeys. There is much potential for MaaS, but most involve a transport service based on user-based and personalized, free digital payment, ticketing, trip planning, and management. MaaS has the potential to enable more efficient use of transport systems trip planning and management. MaaS can allow more efficient use of transport systems, which is particularly interesting to policymakers (Pournader et al., 2020).

Consumer demand for MaaS is driven by several trends, including the desire to move from an ownership to a usage model. This trend now impacts the transport sector with innovations, providing consumers with on-demand access to road vehicles and bicycles (Oham et al., 2018). MaaS is not only limited to the movement of people but also covers the movement of goods. In the next decade, the freight sector transport, and logistics sectors will continue to face increasing demand due to population growth and increased e-commerce (Miraz et al., 2019).

Global supply chain networks are very complex. Many stakeholders (manufacturers, land transport providers, warehouses, freight forwarders, on-demand brokers, governments, ports, air carriers, and end customers) have to interact in different operational transactions. This complexity, especially with multiple data exchanges in the processes, can lead to increased insecurity in cybersecurity and fuzzy insight. Blockchain technology could yield collaboration, reliable information, and consensus, in this case, of a physical object across supply chains (Elagin et al., 2020).

A single version of the truth could be established in seconds instead of hours or days, optimizing capacity utilization. This would be particularly beneficial in global trade, for example, the One Belt, One Road initiative to better connect European and Asian countries, including the U.K. and China. It could also improve competition and reduce risk by increasing reliable information on supply chain actors, especially when two entities are trading for the first time (Koh et al., 2020).

The ability to track the history of a shipment is critical when observing a problem regarding a commodity. This is particularly true for food. Each member acting along the supply chain could record a blockchain when goods have been transferred from one entity to another. New transfer information will be added to the blockchain only when validated with the consent of other members of the supply chain network (Li et al., 2019).

The collaboration between food companies Walmart, IBM, and the University of Tsinghua to explore the use of blockchain to ensure supply chain integrity was launched in 2016. It was found that the detection of the origin of mangoes by traditional methods took six days, 18 hours, and 26 minutes, compared to the detection of the source carried out using blockchain, which took 2.2 seconds. Therefore, the issues concerning a particular product can be identified and corrected faster using blockchain. However, the two methods' full benefits and costs are not publicly available (Pournader et al., 2020). Organizations in the freight transport and logistics sector may take months and years to establish trust relationships with their suppliers, which presents two critical barriers to System optimization. The first involves wasting spare capacity when trusted suppliers need help to use it. The second obstacle lies in the fact that existing "trusted" suppliers may experience operational difficulties at a particular time, which the contracting organizations may not be aware of. The latter may lead to delays, congestion, and adverse effects on revenues (Oham et al., 2018).

An intelligent contract-based industry, where contracting takes place, payments are made in real-time, and current performance ratings of companies are automatically recorded on a blockchain after each transaction, could lead to greater collaboration between organizations. The first transaction with new suppliers would become more accessible and more reliable, contributing to increasing competition, utilizing capacity, and reducing the risk of poor performance (Miraz et al., 2019).

5.2.Digital logistic Platforms

Digital logistics platforms are technological solutions that connect shippers, carriers, and other logistics service providers through a web-based interface. These platforms enable businesses to manage their supply chain operations more efficiently, from procurement to delivery. They provide an end-to-end view of the supply chain, allowing companies to track inventory, work orders and optimize logistics operations.

Digital logistics platforms can leverage technologies such as big data analytics, A.I., IoT, and blockchain to view the supply chain comprehensively. Some of these platforms' core features include real-time shipment tracking, automated freight matching, optimization of routes and capacity, and providing insights into network performance.

The benefits of digital logistics platforms can vary depending on the venue and business requirements. However, some notable advantages include reduced shipping and transportation costs, better inventory management, increased visibility and control over the supply chain, improved customer satisfaction, enhanced compliance, and greater operational efficiency. By enabling businesses to manage their logistics operations more effectively, digital logistics platforms can help them gain a competitive edge in the marketplace.

In particular, Transport Management applications are defined as decision-support tools in the planning, optimization, and execution of transport operations. (Mason et al., 2003). According to Mason et al. (2003), these applications help planners select transportation modes, manage freight consolidation operations, and coordinate the company's shipments. Typical functions include freight quotation carriers, routing and scheduling, tracking and tracing shipments, and freight payment and control (Gilmore & Tompkins, 2000). Despite the growing interest of researchers in the general field of ICT applications for transport, there are still few empirical contributions to the literature aimed at analyzing the adoption of the impact of transport

management applications in the logistics and transport industry. Button et al. (2001) give an example that focuses on a courier company and measures the effects of a transport management application shortly after its development and implementation. The results show an overall increase in productivity in terms of driver performance, as well as a reduction in pressure on dispatchers.

Digitalization has various levels, which start from the inside part of an organization, and form the basis for providing the required functionality of its operations. In addition, digitalization activities outside the organization are increasing and becoming necessary for further collaboration between the rest of the transport agencies and for creating a common communication infrastructure. Thus, digitization in the freight industry is inevitable. New technologies are transforming the whole business world, and there are many reasons for this digital revolution, but mainly because of its many advantages (Kersten et al., 2017). Although digitalization in the freight transport industry has been slow, all players must follow technological developments to join the global transport industry. According to studies, 250 million invoices are issued annually (8 % of them electronically and the remaining 92 % electronically). It is becoming clear that the primary benefits to be gained from the adoption of a digitalization method such as e-invoicing are:

- savings in amounts proportional to the profits of each company
- an increase in transport productivity and speed
- reduction in infrastructure costs, and
- reduction in productivity and speed of document processing reduces tax evasion and delinquency.

5.3. Augmented reality

Augmented reality (A.R.) can be a valuable tool in freight transportation as it offers several benefits that can enhance the industry's operations. Below we will analyze some ways A.R. can be used in freight transportation:

5.3.1. Load optimization

Load optimization is a critical element of freight transportation, as it ensures maximum use of resources available to transport cargo at minimum costs. It maximizes operational efficiency by increasing payload capacity while decreasing total distance traveled. Intelligent algorithms and technologies allow maximum load factor optimization in realreal-timeading to greater productivity and lower costs. Research studies have proven that adopting load optimization

techniques significantly increased operational efficiency, reduand ced wait times and fuel consumption. Liu & Wang (2015) assert that load optimization can also help minimize environmental impacts associated with freight transportation by transporting maximum cargo with minimum resources - thus decreasing vehicle requirements to haul it all (Liu & Wang 2015).

Load optimization can reduce carbon emissions and mitigate climate change effects. Numerous studies have examined its impacts. Studies on load optimization and its effect on carbon emissions have generally reported positive outcomes; Zhang and Shen (2019) conducted one such investigation demonstrating its beneficial results, such as reduced carbon emissions through load optimization. According to findings, scan reduce emissions by up to 50 percent in freight transportation systems. But this complex process must involve all relevant parties, including shippers, carriers, logistic service providers and logistic service users.

Integration between transportation providers is crucial for seamless collaboration throughout the transportation process and effective integration can also lower overall transportation costs. Sharing information such as real-time location data and cargo weight can enable carriers to optimize load factors and decrease empty miles, according to research conducted by Lee and Lee (2019). Load optimization directly impacts customer satisfaction through faster and more efficient delivery of goods. Optimized loads reduce turnaround times, speed up deliveries, and allow companies to offer customers better delivery windows.

Companies prioritizing load optimization tend to be seen as more reliable and efficient, leading to higher customer satisfaction. According to research by CBRE, companies prioritizing load optimization are generally perceived as more reliable and efficient, leading to greater customer satisfaction. Shang et al. (2019) discovered that load optimization increased customer satisfaction levels of shipping services by approximately 25% through reduced transit times and more reliable services.

In addition, it has become an integral component of modern freight transportation, offering numerous benefits - including increased operational efficiencies. The three goals of load optimization are environmental impact reduction, customer satisfaction enhancement and cost cutting. Literature has highlighted the significance of an integrated approach involving various stakeholders, cutting-edge technologies and intelligent algorithms for achieving load optimization.

5.3.2.Real-time tracking

A.R. technology allows freight tracking in real-time. It monitors cargo and vehicles transporting it, helping ensure timely delivery while limiting potential damages to goods.

Driver Training: A.R. can offer virtual driver training services for drivers and other personnel involved with freight transportation processes, helping simulate potential scenarios during deliveries. Hence, drivers are better prepared and equipped to deal with difficult circumstances.

Figure 3: https://www.dispatchtrack.com/blog/real-time-delivery-tracking

Safety Inspection: At A.R. we conduct safety inspections of freight vehicles to ensure they comply with safety standards and regulations, helping detect defects before they cause more significant problems to provide both driver and cargo remain secure and safe.

Overall, A.R. technology offers enormous value to the freight transportation industry. From load optimization to customer experience, this innovative solution helps improve overall efficiency, safety and operations within this niche industry.

5.4.Green technologies

Green technologies in transport sectors can significantly boost international trade by cutting carbon emissions, improving energy efficiency, and strengthening competitiveness on global markets. This is particularly pertinent given current concerns surrounding globalization's effects on environmental sustainability. Literature shows that trade liberalization can harm local pollutants (OECD, 2016), yet technological innovations could help counter this effect. One

way of decreasing carbon emissions related to trade could be implemented through policies supporting energy efficiency.

As part of more considerable efforts, measures could include investments in clean technology or incentives for companies to switch from high-carbon fuels to less polluting sources (Unknown Author, 2015). Taking these steps aligns with more comprehensive efforts.
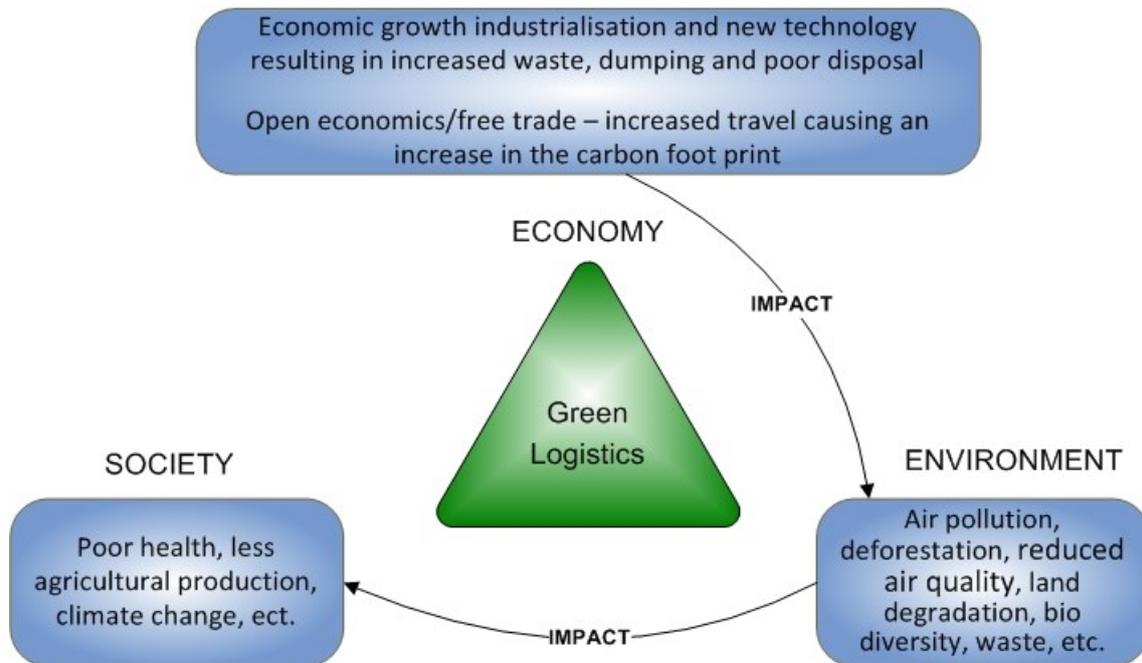
Figure 4: Green Logistics, Source: https://wgeco.org/green-logistics/

According to United Nations reports, sustainable technologies are essential in meeting international climate agreements' targets for sustainable development. According to this organization's estimates, transportation logistics is an additional consideration when looking at green technologies to stimulate international trade. Sustainable transportation systems are integral for economic expansion while mitigating adverse effects on human health and ecosystems, according to a 2021 report by The League of Transportation Innovation. Improving fuel economy standards and adopting alternative fuel solutions contribute to this objective.

Biofuels could significantly reduce greenhouse gas emissions while decreasing industry stakeholders' costs. Further, green technologies present opportunities to strengthen competitiveness in global markets where consumer preference increasingly favors environmentally sustainable products and solutions. Governments must incentivize investment in environmentally-friendly transport solutions as part of more effective national strategies to foster economic development while safeguarding natural resources - though challenges may be associated with doing this effectively.

Integrating green technologies into current transport infrastructure may require significant upfront investments; for instance, retrofitting older vehicles with more energy-efficient engines or switching entirely away from fossil-fueled modes of transport requires considerable capital expenditures. However, initial expenses must be balanced against potential long-term gains such as lower operating expenses due to reduced fuel consumption rates.

Overall, green technologies in transport offer numerous benefits that extend far beyond just reduced CO_2 emissions that lead directly to decreased pollution; increased energy efficiency; and overall increased competitiveness on an international scale. Governments should lead in supporting these technologies with policies that encourage investment and foster innovation within this space.

6. Road transportation

6.1. Autonomous vehicles

Autonomous vehicle development can create a revolution in international trade. Transportation costs remain one of the primary obstacles facing cross-border trade companies today; autonomous vehicles can significantly decrease these expenses while increasing efficiency. It is pointed out that autonomous cars could transform international trade by drastically cutting transportation costs and saving businesses time on logistics processes.

Nuruzzaman (2020) states, "Autonomous driving technology could decrease human error while improving highway safety standards, speeding up travel times as it could travel nonstop without stopping to rest or take breaks for breaks or rest periods. Furthermore, this innovation will aid businesses and society by decreasing carbon emissions from transport activities and offering eco-friendly logistics solutions - although some concerns exist regarding job loss due to this progress.

Automating production ensures that new software engineering and AI maintenance jobs will emerge, creating more positions than were available before automation began. Finally, autonomous vehicle technology holds great promise to transform international trade by opening new routes for trade between nations. Make shipping faster, cheaper and more eco-friendly simultaneously by modernizing its system - exciting prospects that promise enormous benefits for consumers and businesses alike - now and into the future!

6.2. Big data analytics

Big data analytics uses sophisticated algorithms and technologies to process large volumes of structured and unstructured data from different sources, such as social networks. Sensors, GPS devices and social media platforms all contain massive amounts of data which has garnered increasing interest for road freight transportation applications in recent years due to its potential advantages. Companies can make informed decisions regarding route planning and fleet management by analyzing real-time traffic patterns and weather conditions or relevant factors like fuel consumption rates or vehicle maintenance records.

Big data analytics can increase supply chain visibility by providing insight into inventory levels at each step from production to delivery, offering greater coordination between suppliers and distributors while decreasing stockout or overstock situations that lead to additional expenses. Furthermore, big data analytics promises to revolutionize road freight transportation by optimizing logistics operations and increasing supply.

Recent advances in "Big Data" provide powerful new ways of increasing visibility while decreasing costs, providing information such as individual behaviors and activities in addition to aggregated patterns using conventional datasets. Big data analytics have demonstrated enormous promise as an enabler to transform road freight transportation by improving logistics operations, increasing supply chain visibility and decreasing costs; employing these solutions may lead to promising outcomes that significantly improve public transport efficiency (Silva 2021).

The road freight transportation industry could become more efficient and less costly with the increased use of advanced technologies like big data analytics. Leveraging big data analytics tools such as predictive modeling algorithms and real-time tracking systems, logistics companies can optimize their operations through tools such as historical shipment data analysis to forecast demand patterns accurately, planning accordingly to avoid disruptions during transit or unscheduled stops or delays during their routes.

By tracking recent trends in fuel pricing and traffic patterns across various routes in real time using intelligent routing systems powered by machine learning algorithms, logistic companies can optimize transport routes more effectively for greater efficiency. The implications are far-reaching; if implemented correctly, these measures would improve delivery timescales while lowering operational costs significantly, resulting from better utilization of resources such as fuel consumption optimization. Moreover, enhanced supply chain visibility will enable

stakeholders at every point across the transportation process to have detailed information about product location & status at any given time leading to more efficient planning & management.

Future research should focus on exploring how best-existing technologies, such as IoT devices coupled with A.I. capabilities, could facilitate the creation of an integrated platform capable of providing end-to-end supply chain visibility while ensuring optimal resource allocation. This study should also investigate the viability of implementing blockchain technology within a similar system architecture to share sensitive information among parties involved in logistics processes securely. Furthermore, it may be worth researching how digital twins (a virtual replica) combined with deep learning techniques could improve centralized decision-making processes using simulation scenarios based on past performance metrics collected from similar situations faced previously by organizations involved in road freight transportation business sectors.

6.3. Blockchain technology

Blockchain technology has become a buzzword, and its potential applications in the transportation industry are enormous. The road freight transport sector is not exempted from this impact. Blockchain technology could revolutionize this sector by improving the efficiency, transparency, and security of logistics operations. One area where blockchain can significantly improve is data sharing among stakeholders. According to www.lawofthelevel.com (2017), blockchain technology may allow companies and individuals to securely share their driving information while accessing the data contributed by others through secure marketplaces. This means carriers, shippers, drivers, and other stakeholders can exchange real-time information about load status updates or driver availability without intermediaries' involvement. Moreover, IBM Institute for Business Value (2021) suggests that transportation companies today must solve increasingly complex problems faster than their competitors. Blockchain's decentralized nature allows for more incredible speed of execution as it eliminates intermediaries' involvement in processes such as payment processing or document verification.

Another critical pain point that global supply chain leaders face today is the need for inventory visibility during transit (Infosys Limited, 2020). Imagine if all parties involved had access to each shipment's location and status on the distributed ledger. There would be an improved collaboration between shippers, carriers, and third-party logistics providers resulting in increased accuracy with better planning practices for routing shipments and reduced costs

associated with stockouts due to delays caused by unforeseen mishaps within the supply chain process.

In addition to inventory management benefits provided by integrating blockchain into road freight transport services, workflows will come with improved sustainability measures since tracking products throughout their journey facilitates responsible sourcing practices enabling more sustainable distribution models benefiting businesses looking beyond just profit margins but also prioritizing environmental initiatives The implementation of such a system would address existing inefficiencies within current systems which have been known historically prone errors when handling documentation needed at border crossings leading towards reduced wait times saving time & resources while ensuring compliance standards met seamlessly simultaneously providing an added layer of security through verification via blockchain technology as well. In conclusion, the road freight transportation industry stands to benefit significantly from blockchain technology's adoption. Supply chain stakeholders can improve collaboration and reduce inefficiencies with increased transparency and efficiency in logistics operations while creating more sustainable solutions.

6.4.Connected vehicles

Connected vehicles promise to revolutionize road freight transportation by improving efficiency, cutting costs, and increasing safety. Connected Automated Road Transport (C-ART) systems offer one avenue through which connected vehicles may transform road transportation operations. The c-ART system represents one such approach to reaching these objectives. Alonso Raposo et al (2017) provide details regarding this framework as part of their study that defines it for C-ART development.

C-ART encompasses technology, infrastructure, human factors and data in its design to optimize efficiency by increasing coordination among different vehicles while decreasing errors due to human factor errors. Including all four aspects into its system design may have the power to increase coordination across vehicles while decreasing human errors that cause errors due to human factor issues.

Autonomous truck platooning could bring many advantages, including expanding existing road capacity while decreasing fuel usage via draft drafting and mitigating emissions, as Sun et al. 2021 described. Sun also suggested that this concept could enable more significant vehicle fleet

consolidation for better efficiency on busy routes while attenuating emissions through reduction. This idea of truck platooning remains widely debated today.

Convoy delivery involves several trucks traveling closely together in close formation under electronic control by one driver to reduce aerodynamic drag for improved fuel economy without compromising delivery speeds or quality. But while such transport models could save on costs by eliminating aerodynamic drag, convoy delivery poses potential safety concerns due to increased traffic jams between them and reduced congestion costs for localized delivery routes. Liu et al.'s (2019) suggestion suggest that current perception process shortcomings require properly prepared road infrastructure; with this preparation including road markings/signage it will be easier for autonomous systems to function effectively.

Trucks rely heavily on sensory information from cameras/lidar/radar sensors installed in their fleet to safely navigate their surroundings, including sensory input from cameras/lidar/radar sensors installed. In addition, further research needs to be done on how connected vehicles can interact with other forms of transport, such as rail or air freight transportation networks, so that seamless integration becomes possible, leading to more sustainable logistics operations overall, benefiting both businesses & society at large. Overall Connected Vehicles, if adequately integrated into Freight Transportation Networks, have a tremendous potential impact not only regarding increased productivity/efficiency but also creating safer/more reliable supply chains, ultimately helping businesses reduce operating costs while making roads safer for everyone involved, not just drivers but also pedestrians, cyclists, and other road users.

Integrating technology into logistics management systems leads to unprecedented opportunities for optimization, streamlining, and increased productivity. Connecting trucks through wireless communication allows them to share data, coordinate routes and reduce highway congestion. The implications of this development cannot be overstated. Connected vehicles allow companies to track shipments from points A to B more efficiently than ever while reducing fuel consumption by optimizing delivery schedules based on traffic patterns or weather conditions. The cost savings associated with such technologies can make businesses more competitive by improving lead times and expanding their reach without sacrificing quality control or risking late deliveries.

Furthermore, connected vehicle technology improves road safety by warning drivers about potential hazards ahead, including accidents or poor weather conditions that could affect visibility or impact vehicle performance. These advanced features also enable faster response

times when managing emergencies or breakdowns. However, companies need infrastructure investments for Internet-of-Things (IoT) devices like sensors that transmit data between vehicles and central management systems that receive real-time updates from every truck participating in their network. In conclusion, connected cars are poised to transform road freight transportation significantly; they offer great promise in increasing efficiency while reducing costs and boosting safety levels simultaneously - all vital concerns for the industry's growth prospects.

7. Sea Transportation

New technologies have revolutionized sea freight transportation, increasing efficiency, reducing costs, and enhancing sustainability. In today's global economy, the shipping industry plays a crucial role in the movement of goods across borders. Sea freight transportation is one of the most cost-efficient long-distance cargo transportation available today, and has long been utilized within maritime industries worldwide. Technological advancements continue changing the marine sector into something more efficient and eco-friendly.

Automation systems, digitalization initiatives and alternative power sources like electric propulsion systems or renewable fuels have revolutionized cargo transportation via sea. Over recent years, more attention has been directed at cutting emissions caused by shipping industries as they contribute to air pollution and climate change; by employing green technologies the shipping industry could reduce their carbon footprint substantially. Companies that invest in hybrid engines or wind-assisted propulsion systems can reduce both carbon footprint and operational expenses associated with fuel consumption, thus significantly cutting operating costs.

Digitization has provided optimization opportunities across the supply chain process, from port operations and vessel routing, through vessel tracking and cargo monitoring, using AI algorithms integrated within management software applications to predict disruptions in real time and optimize routes based on weather patterns, conditions or traffic congestion. While digitalization has enabled efficiency gains within sea freight transportation operations, its advancement still poses security threats when transporting valuable goods such as high-tech electronics or hazardous substances like salt water.

Shipping hazardous chemicals by sea necessitate rigorous regulations and compliance monitoring systems in place worldwide, in addition to worldwide monitoring compliance procedures being established and in force.Overall, technology innovations continue advancing rapidly, resulting in an exciting future ahead where ocean carriers will be able to provide better services in both economically and environmentally friendly ways, simultaneously benefiting businesses globally, allowing them to reach farther markets faster, ultimately improving consumers' lives through lower prices and higher quality products delivered quicker all thanks advances made possible innovative solutions developed cutting-edge science engineering fields increasing productivity along value chains driving growth prosperity forward continuously bettering the world around us every day.

7.1. Autonomous ships

The advent of autonomous ships has sparked a revolution in the shipping industry. These crewless vessels can improve efficiency and reduce costs while drastically minimizing human error. According to a recent report by Allianz Global Corporate & Specialty, human errors are responsible for up to 75% of marine accidents, leading to massive financial losses and loss of life. Automobile ships can circumvent this issue by removing humans from the equation. This technology is up-and-coming for long-haul voyages where crew members may experience fatigue or face harsh weather conditions, risking their safety. Despite these benefits, some have expressed concerns about the potential impact on employment in the industry.

However, it is essential to note that while autonomous ships will undoubtedly require fewer onboard crew members, they will still rely heavily on remote operators overseeing all vessel operation aspects from shore-based control centers. Additionally, as with any new technological advancement, there may be a period of adjustment before widespread adoption occurs. In conclusion, while there are valid concerns about its effects on employment within the industry; however, the implementation of autonomous ships would significantly change how businesses operate through enhanced efficiency and reduce risks associated with human error. It is an innovation that could lead to more sustainable operations within logistics - not just financially but environmentally.

The adoption of autonomous ships represents a significant shift in the maritime industry. As technology advances, it is becoming increasingly possible to automate complex processes humans once performed. One area where this shift has the potential to make a profound impact

is safety at sea. The risk of human error has long been a concern for sailors and shipbuilders alike, as even small mistakes can lead to disastrous consequences. Replacing humans with automated systems can significantly reduce this risk and improve safety. However, some may argue that relying solely on autonomous ships may be partially foolproof due to occasional system failures or malfunctions leading to catastrophic accidents. However, studies have shown these occurrences are rare (Ruffel et al., 2018).

Nonetheless, many challenges are still associated with implementing autonomous shipping technology at scale. For example, ensuring compatibility between different systems and addressing cybersecurity concerns remains an ongoing issue (Li et al., 2020). Nevertheless, these obstacles should encourage us to pursue this promising avenue for improving safety at sea.

To this end, adopting autonomous ships presents an opportunity to reduce risks associated with human errors in sailing operations while providing new technological advancements toward future marine transportation solutions (Ruffel et al., 2019). While challenges remain in scaling the deployment of such vessels (Li et al., 2020), their benefits outweigh their drawbacks-making them worth considering as part of any forward-thinking approach toward enhancing marine safety standards globally.

The development of autonomous ships raises essential ethical and legal questions, such as who would be responsible for accidents and how to ensure the security of the vessels. While proponents argue that these ships will reduce human error, increase efficiency, and lower costs, skeptics worry about their safety implications. A recent study by The American Society of Civil Engineers (ASCE) states that "autonomous shipping technology is still in its infancy with significant research challenges remaining unsolved." This underscores the need for continued exploration into the numerous complexities surrounding autonomous ships before they are widely adopted. Additionally, current maritime law must address this issue because most existing regulations assume a crew is always on board.

Further complicating matters are concerns over cybersecurity risks associated with these ships. Researchers have already demonstrated navigation system vulnerabilities that could lead to hijacking or collisions. As we move towards greater adoption of autonomous shipping technology, industry leaders must grapple with ethical dilemmas such as those outlined above. Ultimately these issues will require thoughtful consideration from all stakeholders, including government officials, industry experts, and regulators alike, to create policies that prioritize

both public safety and innovation while also addressing complex ethical considerations set forth by emerging technologies like autonomy at sea.

7.2. Smart containers

Smart containers have revolutionized the shipping industry by providing real-time data about cargo conditions and waste reduction while improving efficiency. Their popularity among industry members stems from their ability to address various concerns with shipping operations.

According to the White Paper on Smart Containers v1, these devices enable constant tracking of goods. Shippers can use transit monitoring data to help identify potential issues during transport such as temperature variations or damage caused by mishandling (UNECE-UN/CEFACT, 2018). By keeping an eye on shipment progress during its journey, shippers can detect issues like temperature variations or damage caused by mishandling (UNECE - UN/CEFACT, 2018).

Smart containers give shippers real-time information regarding damaged and perishable goods, helping them take proactive measures against losses due to spoilage or damaged items. Thanks to this capability, intelligent containers effectively enable shippers to prevent loss due to damaged or perished goods.

Since global trade volumes have skyrocketed over time, more advanced technologies will be necessary to meet rising requirements. As smart containers provide accurate tracking information throughout their supply chains, they help minimize delays and accelerate delivery times, ultimately increasing business profitability.

As all stakeholders involved in shipping operations - from manufacturers to retailers - gain immediate access to shipment status data at all times, intelligent container tracking solutions have proven their worth by streamlining processes and eliminating bottlenecks. Unsurprisingly, many businesses are investing heavily in smart container technology solutions. In addition, more and more organizations seek ways to streamline their logistics operations with modern technology, and traditional methods of cargo transporting may remain prevalent globally. But more innovative alternatives, like using intelligent container solutions are emerging worldwide.

Smart containers dramatically impact supply chain management, improving goods tracking and visibility while simultaneously revolutionizing supply chain operations, according to Voorspuij

and Schroder(2020). Voorspuij and Schroder suggest "smart containers are revolutionizing supply chain operations by facilitating better tracking of goods while increasing visibility throughout supply chains". They explain further: this transformation was made possible thanks to advanced sensors and monitoring systems. UN/CEFACT's Smart Container Project Status Update details this development through new data elements requiring code lists such as sensor category, reefer data, sensor type and device type (Voorspuij & Schroder 2020). Numerous sensors were implemented for improved monitoring purposes - location sensors, temperature and humidity sensors are some examples that have been installed - according to Voorspuij and Schroder's study article sample. By having supplier updates readily accessible for businesses to track orders more efficiently.

Integrating smart containers and blockchain technology has revolutionized supply chain management; Bolte & Pieper (2018) state that this innovative solution allows companies to increase customer service without incurring unnecessary inventory costs. Additionally, smart containers increase transparency and accountability during goods movement by providing more visibility of requirements, inventories and information flows about containers currently circulating.

Bolte & Pieper (2018) have concluded that tight control in shipping processes benefits all stakeholders by minimizing errors and offering an accurate picture for decision-making purposes. Innovative container technology such as real-time tracking allows shippers to know precisely where their goods are at any given moment during transit; in additiblockchain also additional transparency. Unalterable digital ledger that fosters trust between parties by sharing data openly without intermediaries or third-party intervention is provided by intelligent containers equipped with blockchain technology, creating many advantages over alternatives. Companies can streamline their supply chain operations while upholding integrity and security.

7.3. Improved vessel designs

Over recent decades, technological innovations have transformed the shipping industry substantially. Improved vessel designs have increased efficiency while decreasing costs in sea cargo transportation - an observation made by United Nations Conference on Trade and Development (2022). Shipbuilders today have designed vessels specifically to reduce drag, reduce fuel usage and maximize cargo capacity - this has allowed shippers to transport more goods with fewer costs.

Modern ships utilize cutting-edge navigation systems that enhance safety while optimizing fuel usage for cross-national journeys, significantly cutting operational costs and passing savings along to customers through lower freight and reduced shipping rates. The savings from such ship designs can be passed via lower freight rates for customer shipments or lower shipping prices.

As environmental regulations around the globe become stricter by imposing carbon taxes or restricting emissions levels of cargo ships entering ports, companies within this sector must invest more in research and development to increase sustainability. Furthermore, as carbon taxes or emission limitations for cargo ships entering ports become mandatory regulations worldwide, investing more into research and development for sustainability has never been more critical. Newer vessel designs incorporate more efficient technologies that contribute positively to financial performance and ecological responsibility measures of firms operating global sea cargo transportation services. Overall, improved ship designs increase financial returns while contributing to more extraordinary environmental responsibility measures within companies in this field. By cutting fuel usage while increasing goods volume per trip via innovative engineering approaches, supply chains can keep pace with consumer needs and maintain competitiveness and integrity towards sustainability goals set out by legislation or stakeholders.

Recent years have witnessed significant advances in ship design and technology within the shipping industry, which has contributed to improving safety measures during cargo transportation and crew travel time. According to UNCTAD (2021), advanced vessel technologies "have enhanced safety measures during both crew transportation as well as cargo shipping", making travel safer for crew and cargo alike. This has happened via improved vessel design technology that improves cargo protection measures during transportation.

Advanced sensors that use advanced detection sensors to predict potential hazards before they become issues are one way modern vessels have improved safety. One such way advanced technologies have enhanced shipboard safety is through collision avoidance systems that use radar, GPS and other technologies such as to monitor surrounding vessels and obstacles such as collision avoidance systems on vessels utilizing collision avoidance technologies like collision avoidance radar systems that use radar technology with GPS for collision avoidance purposes and barriers monitoring capabilities on many modern vessels. Satellite communications enable crew members to stay in close touch with shore-based support teams

as well as vessels onboard so in case an emergency arises quickly assistance can be summoned quickly when help must be rapidly summoned from shore-based support teams or ships at sea which provides more excellent connectivity so aid can arrive swiftly when help may be called quickly from ships at sea or shore-based support teams allowing crew members access quickly to shore-based support teams or vessels in case an emergency situation arises enabling crew members to get help more rapidly when an emergency situation occurs quickly or be summoned promptly when help will arrive soon to assist quickly or gather help quickly when support comes in an emergency situation occurs quickly so help can arrive promptly to be summoned soon from ships on scene or vessels nearby with help arriving quickly so help can arrive quickly when help will arrive soon when required quickly to assist quickly if required quickly or quickly needed quickly when swiftly required as fast and be summoned soon quickly when required quickly from shore-based support teams or vessels nearby quickly enough for prompt dispatch as needed when needed in time or should arises occur while being requested on scene quickly needed quickly when necessary quickly or necessary in case emergency occurs derived need be required when necessary and assist.

Communication systems also allow captains to receive real-time weather data, simplifying route planning decisions. Overall, vessel design plays a pivotal role in safety. Technological progress has had an immeasurable positive effect on maritime transportation by improving safety conditions for everyone involved. We may yet experience further profound shifts thanks to technological innovations; until that day comes, however, let us recognize all that has already been accomplished thanks to technological progress. Innovative vessel designs have changed the shipping industry by making transporting larger or heavier loads across oceans more cost-effective (UNCTAD 2021). Remyha (2023) emphasizes how such vessels enable businesses to expand their global trade and commerce capabilities and that these innovative designs play a pivotal role.

Transportation capacity constraints should allow trade agreements at international trade conferences and conventions. One solution to this challenge has been the rise of container ships capable of transporting up to 24,000 twenty-foot containers simultaneously, an innovation with significant economic advantages over traditional cargo vessels as they reduce per-container costs while improving speed and safety.

However, this increased capacity comes with its own set of challenges. Larger vessels require deeper ports and longer berths for loading/unloading operations; thus, port infrastructure must

be continuously upgraded to meet these requirements (Remyha, 2023). Additionally, enormous investments are required throughout the supply chain to efficiently build or adapt facilities capable of handling such high volumes. Nevertheless, it cannot be denied that innovative vessel designs have boosted global trade and commerce significantly. Enabling more efficient transportation of goods across great distances than ever before has brought about an era of unprecedented economic growth worldwide.

8. Air Transportation

8.1. Smart airport

Air freight transportation is integral to global economic prosperity, facilitating efficient goods movement across borders. But its challenges can be formidable; air cargo industry's dynamic nature requires innovative approaches. Smart airports have revolutionized air freight transportation by integrating cutting-edge digital tools like AI, IoT sensors and Big Data analytics into existing infrastructure to maximize efficiency and minimize costs. As a result, this has increased speed while simultaneously decreasing costs (Joe et al.)

Cargo handling processes have seen significant improvements, including enhanced visibility across supply chains, automation to streamline operations, and faster customer delivery times. Implementing smart airport infrastructure has paved the way for continued innovation in cargo handling operations.

Figure 5: Smart Airport Market Forecast to 2027

According to Waris et al., innovative airport technology has transformed air freight transportation, significantly decreasing energy use and carbon emissions. These technologies are helping streamline processes and boost efficiency throughout the supply chain by providing real-time tracking of shipments, automating cargo handling operations and improving route planning/traffic flow optimization. Thanks to technological advancements, This state-of-the-art infrastructure provides seamless coordination among stakeholders involved with air freight transport such as airlines, shippers, regulators and ground handlers.

Airports that incorporate innovative IoT systems capable of sharing data across platforms have seen their logistic capabilities expand through interconnectivity, enabling efficient communication among various parties involved. Innovative technology adoption leads to faster transaction times and reduced delivery costs, increasing productivity levels while decreasing errors (Waris et al., 2022). Airport technology is revolutionizing air shipping by improving efficiency and safety with features like facial recognition software monitoring who enters restricted areas. Smart airport infrastructure implementation has produced significant results in air shipping efficiency and safety. Rubio-Andrada et al's (2023) findings point towards this shift as sustainable practices that reduce energy usage and carbon emissions are implemented, providing an eco-friendly freight transportation option.

The approach has proven highly successful at lowering the carbon footprint associated with air travel. Utilizing technological solutions such as automated cargo handling and intelligent lighting systems, airports can operate more efficiently while lessening their environmental impact. Renewable energy sources like solar power help this initiative succeed by offering cost savings for airlines and airports, according to Rubio-Andrada et al (2023). Furthermore, these advances have permitted for improved management. Sustainability has become a top priority across industries worldwide; aviation is no exception. Implementing intelligent airport infrastructure offers an opportunity for improved efficiency.

8.2. Digitalization

Digitalization can offer stakeholders within the industry an excellent opportunity to take significant strides toward reducing their environmental impact and work toward meeting long-term sustainability goals.

Technology advancements are quickly reshaping how goods are transported, which explains why digitization has become more prominent within the air freight industry. According to recent studies, companies embracing digital transformation tend to outshine competitors by improving productivity and increasing profits.

Air cargo management can improve operational efficiencies and customer satisfaction through AI/machine learning integration into air freight transportation. Over recent years, AI and machine learning innovations have become key developments. Modern technologies have transformed how businesses move goods globally, improving speed, accuracy, and safety while guaranteeing timely delivery from origin to destination. Air freight transportation's digitization has proven groundbreaking for this industry.

It is enhancing smooth operations and increasing efficiency. Physical consolidation increases asset utilization while cutting rates; digitization may offer further efficiency gains.Industry experts recently conducted research showing that implementing digital tools like real-time tracking and electronic documentation has significantly enhanced air cargo transport operations and allowed for better decision making.

Decision-making and risk management technology offer significant advantages: increased data accuracy enables companies to proactively mitigate risks while meeting customer deadlines for delivery across borders, thus improving customer satisfaction. Customer satisfaction, cost efficiency and reduced manual labor on paperwork processing while simultaneously decreasing irregularity rates associated with human error are the goals of this model. Furthermore, collaboration among different parties involved ensures better outcomes. Additionally, logistics is made possible through shared access to information and more accessible data sharing, which streamlines work processes throughout the supply chain system for faster turnarounds from origin to destination points. Businesses that adopt these technologies quickly or at all are in a position to gain a significant competitive advantage when it comes to optimizing logistics performance metrics over time.

Air freight transportation is essential to global trade, and its efficiency can profoundly affect economies worldwide. Integrating AI and machine learning technologies into air freight logistics management could revolutionize cargo administration by significantly speeding up cargo transport operations. AI-powered systems that analyze massive amounts of realtime data allow airlines to optimize routes based on weather and traffic congestion while reducing fuel consumption and overall costs. These systems utilize predictive analytics algorithms to predict

maintenance requirements for aircraft parts before they fail or cause delays in delivery times, according to an anonymous report from 2021. "AI and machine learning technology will work hand in hand to achieve seamless operations for aircraft maintenance", as reported by an unnamed source in 2021.

Machine learning's potential in air freight transportation offers excellent potential to improve the speed and accuracy of cargo management, enabling airlines to oversee their fleets better. At the same time, guaranteeing that goods arrive at their destinations safely and on schedule. This technology also has implications for fleet management allowing airlines to ensure goods reach their goals safely.

8.3.Artificial Intelligence

No one could argue with the timely integration of AI technologies seamlessly into global air freight operations' reliability improvement. Although concerns have been raised regarding job losses due to AI taking on tasks previously performed by humans, automation's promise lies in improving global air freight operations' reliability. By integrating existing logistics infrastructure, businesses can increase operational efficiencies while decreasing operating costs due to errors or delays caused by manual processes. There's no doubt about it: adopting digital logistics practices offers definite advantages to any supply chain operation. AI advancements in air freight transportation will bring substantial benefits across multiple industries; it could even transform global commerce.

AI is revolutionizing the air freight transportation industry, streamlining operations and optimizing routes to increase efficiency while decreasing costs. AI has quickly become an essential asset of modern air freight companies - from automating cargo handling systems to streamlining operations. It can significantly streamline aircraft maintenance procedures from handling processes to improving aircraft maintenance procedures - both operationally and environmentally. Environmental benefits are one area in which AI can play an invaluable role.

Reducing fuel consumption through optimized flight routes and schedules is an integral component of sustainability. Airlines can reduce flight duration by employing sophisticated algorithms that consider variables like weather patterns and traffic congestion while cutting their overall costs.

AI in air freight transportation holds great promise for revolutionizing the industry; according to Conde and Twinn (2019), this technology could transform it completely. This happens because it can enable faster and more efficient delivery times, ultimately cutting business and consumer costs. Utilizing machine learning algorithms, AI can analyze data from sources like weather patterns, traffic congestion and flight schedules to provide this insight.

After, automating tasks such as loading cargo onto planes or tracking deliveries in real-time further enhances delivery speed while decreasing human error and improving overall safety. Integrating AI could also aid supply chain management by offering insights into inventory levels and demand forecasting, helping companies adjust operations appropriately and ensure smooth procedures.

Technology-driven logistics solutions will allow companies and consumers to meet customer demands while reducing waste, providing cost-saving benefits to both. While job losses might arise due to this trend, additional business and consumer benefits will result. Despite potential concerns around job security, AI technologies have undoubtedly transformed the air transport logistics sector, providing significant advantages over traditional systems for resource allocation management and optimizing air transport logistics processes - something traditional methods cannot match.

Aviation represents an extensive environmental footprint, responsible for approximately 2.5% of total carbon emissions worldwide (ICAO, 2019). To mitigate its negative environmental impact and maximize efficiency in operations, however, measures such as recycling and alternative fuel are being implemented (Conde & Twinn 2019). Recent AI advances have demonstrated great promise in helping the freight transportation industry reduce its carbon footprint. By optimizing flight routes and schedules using AI algorithms, fuel consumption and emissions can be significantly reduced while air freight transportation becomes much more sustainable. This happens because AI algorithms used to optimize flight routes and schedules can substantially lower fuel consumption and emissions, making air freight transportation more eco-friendly ("The use of artificial intelligence algorithms to optimize flight routes can greatly decrease fuel consumption and emissions, making air freight transportation more ecologically sustainable" (FHWA-JPO-20-787, 2020). These programs use AI to perform this optimization task more effectively.

Environment conditions, aircraft performance data, traffic congestion patterns and historical flight records are considered when creating algorithms to analyze this information in real time

with machine learning models that enhance over time based on experience-based learning. This analysis becomes the foundation for experience-based models that become brighter with each flight. Moreover, training sets allow users to identify the most efficient routes between two points by considering all relevant variables and variables that impact them, including economic and ecological costs associated with unnecessary detours and ineffective routes. Thus, their results could bring economic and environmental advantages by eliminating unnecessary detours or inefficient routes.

AI technology allows airlines to take advantage of emerging technologies while decreasing greenhouse gas emissions, leading to less congestion and lower greenhouse gas emissions. AI also allows airlines to take advantage of emerging technologies while improving their ecological footprint. AI algorithms can rapidly analyze complex data sets, making ideal tools for optimizing flight paths. Companies have also turned towards these innovative solutions as part of an industry sustainability initiative. However, implementing AI technology poses various challenges, including security concerns. But by harnessing its potential power for improving numerous sectors with eco-friendly strategies, including AI's revolutionizing the air freight transportation industry.

Optimizing flight routes and schedules using algorithms has proven to significantly reduce fuel consumption and emissions, making air freight transportation more environmentally sustainable. Furthermore, AI technologies have enhanced cargo handling efficiency. Automating various processes, like loading and unloading, saves time and human error - ultimately cutting company costs through reduced labor expenses. While automated solutions offer significant advantages over manual processes, there may still be potential downsides that should be considered; One primary consideration is potential security threats associated with automation.

Job displacement may increase as automation replaces human labor in various industries. Additionally, as technology becomes ever-more reliant, cyberattacks increase the threat of breaching personal information or disrupting systems if unprotected. Therefore, proper measures must be implemented to protect data security and infrastructure stability to mitigate these risks. Although integrating artificial intelligence (AI) into air freight transportation could present particular difficulties, its potential advantages should still be explored.

9. The Impact of Emerging Technologies on International Trade-Analyzing Effects on Competitiveness, Modes of Substitution, and Country-Product Markets

The possible effects of new technologies on international trade on competitiveness and substitution among modes and between different country-product markets are a topic of great interest in today's globalized world. Businesses have taken advantage of technological innovations to expand beyond their traditional boundaries, but such developments raise many questions regarding their effect on international economics.

Technology has always shaped international trade and commerce, revolutionizing industries with breakthrough innovations that transform processes. Technological breakthroughs are at the core of world development today and continue to shape it further. Transportation methods have changed how goods are traded globally since their invention; from steam engines to containerization. Meanwhile, recent technological innovations like AI have further altered our global trade routes. Blockchain applications, digital platforms for consumer purchases and drone deliveries offer tremendous potential but present distinct challenges. Their effects are far-reaching with positive and negative implications depending on implementation and regulation; policymakers need to know these impacts well if they wish to effectively navigate changes that might impact national economies differently depending on their stage of development.

Emerging technologies have fundamentally transformed international trade, creating new business opportunities to expand and increase competitiveness. Dahlman (2005) suggests that adopting these technologies may offer developing countries significant advantages like increased flexibility and technological capability - plus they now possess more excellent global competition capabilities that enable them to thrive more successfully than before. Investment in new technologies often results in greater profits and expanded reach for companies who make the switch . However, doing so successfully presents unique challenges as markets become more volatile and unpredictable. Attaining success through emerging technology remains crucial, particularly as markets become more dynamic and fragmented.

Businesses must stay ahead of the competition by continually revising their strategies and upholding a solid technological infrastructure, developing new skills in-house as part of an

overall plan to navigate this ever-evolving environment. Although adopting emerging technologies in international trade presents various barriers and benefits; with access to powerful tools like cloud computing, automation software and blockchain technology available, they can streamline processes while significantly cutting costs. Embracing these advancements will prove vital for any company looking to expand its reach across borders while increasing profitability in today's highly demanding global environment (Dahlman, 2005).

Figure 6:https://www.weforum.org/press/2020/12/top-ten-technologies-that-will-change-international-trade-released-by-world-economic-forum/
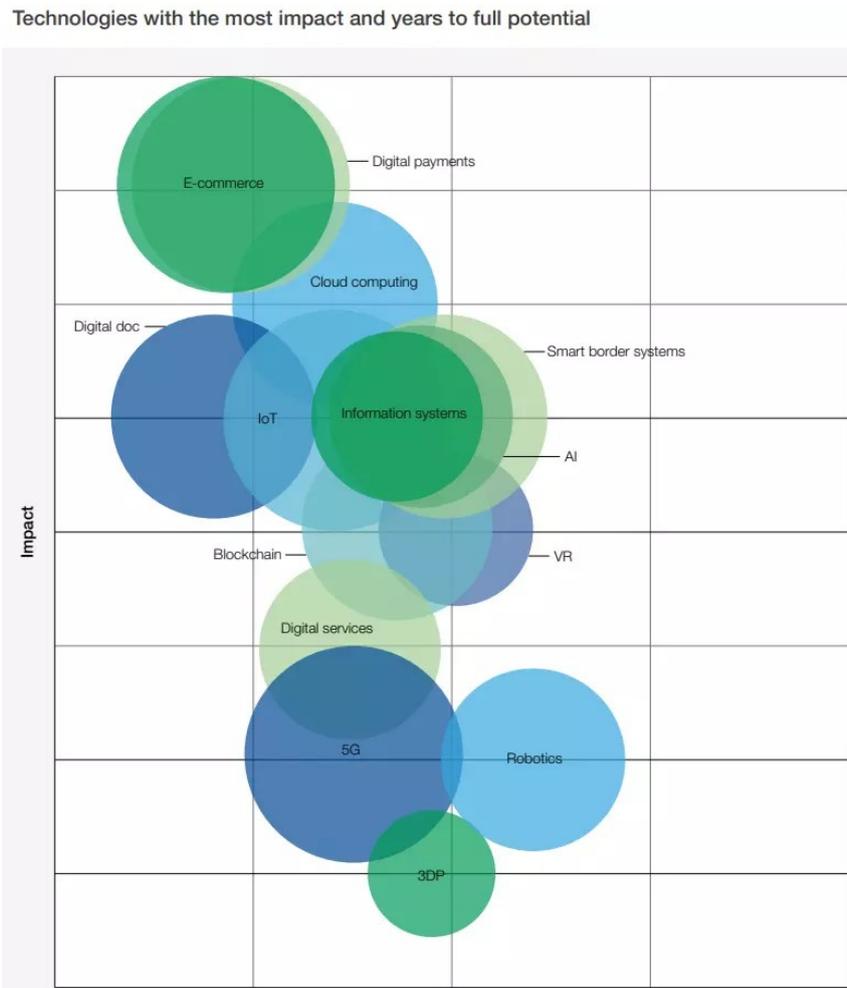
The impact of new technologies on international trade is vast and multifaceted. Integrating these technologies can transform how countries conduct business with one another. However, as we have seen from our analysis, positive and negative consequences could arise depending on how they are implemented. On the one hand, new technologies may lead to greater competitiveness among countries by improving efficiency and reducing costs. This increased competition could result in more innovation and better quality products for consumers

worldwide. On the other hand, rapid technological advancements also exacerbate economic inequality if developing nations need access to the tools or resources needed to compete globally.

Moreover, substitution among modes of transport could significantly change traditional trading patterns between different country-product markets through faster delivery times or lower shipping costs. For instance, e-commerce platforms like Amazon have disrupted the retail industry by enabling global customers to purchase goods directly from producers halfway across the world rather than buying them at local stores. Policymakers must carefully manage this transformational shift towards a more technology-driven future while considering job displacement concerns and environmental sustainability. Ensuring a smooth transition towards implementing new technologies in international trade requires cooperation amongst stakeholders like governments, businesses & organizations.

According to Sussman (2000), possible effects of new technologies on International Trade, the world is constantly in flux. As technology advances rapidly, it is changing the way we do business. In particular, new technologies are having a significant impact on international trade. Sussman (2000) argues that these changes will disrupt traditional commerce patterns and create new growth opportunities. International trade has been an essential component of global economic development since the earliest days of human civilization. However, technological innovations have made new ways to conduct business across borders and facilitated greater exchange levels than ever before. As Sussman (2000) notes, this shift towards increased connectivity has significant implications for international trade.

Through enhanced communication and collaboration, digital communication and collaboration tools can facilitate better communication between trading partners, leading to improved relationships and increased opportunities for growth. Another potential effect highlighted by Sussman (2000) concerns the use of big data analytics to gain insights into market trends and consumer behavior patterns. This information could be used by businesses looking to optimize their operations or enter new markets. Finally, advancements in automation may lead to increased efficiency in production processes but also pose challenges related to job displacement.

Applying new technologies in international trade has revolutionized how companies conduct business. Digital platforms and blockchain technology can enhance transaction speed, reduce costs, and facilitate faster delivery times. Ramberg (2015) states that "new technologies can

increase efficiency and speed of transactions, facilitating faster delivery times and reducing costs." These advancements have decreased transaction timeframes from weeks to seconds while removing the need for intermediaries such as banks and financial institutions that inevitably slow down processes with their bureaucratic procedures. Additionally, automated systems enable real-time monitoring of goods' movement across borders, significantly increasing supply chain transparency levels. However, it is essential to note that implementing these technological solutions requires significant investment in both infrastructure and human capital. This adoption must be carefully planned to ensure compatibility with existing systems while managing potential risks such as cyber-attacks or data breaches. Nevertheless, when executed correctly, the benefits are vast - streamlined operations translate into increased productivity rates, ultimately leading to more competitive pricing structures for consumers. In conclusion, incorporating new technologies into international trade is a worthy pursuit, given its potential impact on efficiency levels.

As emerging technologies continue to evolve, traditional business models in international trade face disruption, leading to new opportunities and challenges for companies. Using blockchain technology and AI is reshaping how businesses operate by increasing efficiency and reducing costs. Philibert (2004) notes that these technological advancements can revolutionize international trade by improving supply chain management, enhancing trust between parties, and facilitating secure transactions.

However, this disruption also challenges companies as they must adapt their operations to remain competitive in an ever-changing landscape. Blockchain technology has enabled faster transaction processing times while reducing intermediaries' role in securing those transactions (Philibert, 2004). Businesses can transfer goods without relying on third-party entities such as banks or insurance companies to facilitate cross-border payments or ensure compliance with regulatory requirements. AI has also contributed significantly to streamlining internal business processes by automating routine tasks such as data entry or customer service inquiries. While these technologies present significant benefits, challenges are associated with their adoption. For one thing, smaller firms may struggle to keep up with larger competitors with more resources for investment in research and development initiatives (Philibert, 2004).

Additionally, ensuring proper security measures when implementing these technologies is vital since breaches could lead to significant financial losses or reputational damage. In conclusion, the emergence of blockchain technology and AI presents opportunities and challenges for

companies operating within international trade. While greater efficiency should translate into cost savings over time once implemented correctly, it is crucial not only how but why we implement them during our adaptation process so that we do not leave behind any negative externalities from its adoption at scale (Philibert, 2004).

The implementation of novel technologies in international trade has ushered an abundance of advantages to the global market. Nevertheless, it simultaneously raises apprehensions regarding data confidentiality and safeguarding. In light of sensitive information being transferred across borders at a remarkable pace, there exists an urgent necessity for worldwide cooperation and regulations to alleviate risks. Ramberg (2015) observed that adopting state-of-the-art technologies can significantly impact sectoral energy consumption and alter crude oil-natural gas price ratios over time. This emphasizes how even minute technological changes can have extensive consequences reverberating throughout industries. In international commerce, cybersecurity breaches are not solitary occurrences but systematic menaces capable of destabilizing economies globally. The reliance on digital infrastructures elevates these hazards exponentially since businesses are now more intertwined than ever before. Therefore, governments must formulate regulatory frameworks that balance innovation and security concerns to guarantee secure cross-border transactions. Only through collaboration among nations may catastrophic results be avoided while simultaneously encouraging technological advancements that benefit all parties involved. Despite modern technologies being beneficial for business operations worldwide, policymakers must recognize possible data confidentiality and cybersecurity issues by jeopardizing their citizens' well-being (Ramberg, 2015). Consequently, different countries' governments should establish effective regulations regarding the technology used to maintain an equilibrium between innovative needs and national security interests universally.

As per Sussman (2000)'s perspective, technological advancements have brought about significant changes in international trade, which can positively and negatively impact global trade. Integrating autonomous machines into the supply chain has resulted in greater productivity and efficiency, reducing business costs. However, it also raises concerns over job security and potential economic repercussions. Additionally, e-commerce platforms and digital marketplaces have made it easier for small-scale businesses to participate in global commerce. This increased accessibility results in a broader range of products available to consumers worldwide but may also lead to increased competition among smaller enterprises. As we navigate this technological revolution era where innovations seem boundless at times- caution

is warranted amid every step taken within our society regarding implementing cutting-edge tech solutions into our economic spheres. Hence, as not only promote prosperity but also ensure fairness amongst all parties involved when developing policies related to that without leaving anyone behind who might be disadvantaged if left out from participating fully either due to lack of access to device resources or knowledge needed to cope up with fluid requirements set forth current trends shaping industry overall progress towards digitization realization goals like.

Conclusion

The transport sector has been transformed by technological advancements, which have brought forth fresh opportunities and challenges. To further international trade, it is crucial to consider cutting-edge technologies that streamline logistics operations and enhance efficiency. The integration of big data analytics has revolutionized the industry as it allows for real-time decision-making and optimization of supply chain management. Furthermore, adopting automation through autonomous vehicles could make transportation more cost-effective while reducing human error significantly. Also, blockchain technology offers a secure platform for efficient monitoring goodof s from source to destination while ensuring transparency and accountability. As we embark on an age of global interconnectedness, acknowledging that technological progress must align with sustainability goals is essential. Thus companies should prioritize eco-friendly practices like electric-powered fleets or biofuels. To summarize, diverse propositions related to new technologies in the transport sector have the potential to promote international trade effectively. From big data analytics to autonomous vehicles and blockchain technology – each innovative technology has distinct advantages that can optimize logistic operations, leading toward sustainable economic growth. It's time for policymakers across nations to actively join forces with stakeholders in exploring these possibilities.

The rapid rise of digital technologies has brought about significant changes in how we conduct our daily lives. The world is increasingly digitized, with electronic transactions and documents commonplace in many aspects of our lives. As such, it is no surprise that there is a growing need for global legal recognition of these transactions and documents to ensure their enforceability and validity across borders. According to "The Promise of TradeTechPolicy Approaches to Harness Trade Digitalization" (publication year not provided), this need for global legal recognition has led to the development of various international instruments, such

as the United Nations Convention on Contracts for the International Sale of Goods (CISG) and the Electronic Communications Convention (ECC). These instruments provide a framework that facilitates cross-border trade by ensuring that electronic transactions and documents are legally recognized in all participating countries. However, despite these efforts towards harmonization, differences still exist among national laws regarding electronic commerce and records. This poses challenges for businesses operating across different jurisdictions.

Thus, while progress has been made toward achieving global legal recognition, more work needs to be done to ensure consistency and uniformity among nations concerning electronic commerce law. Automated cargo tracking drones are the newest addition to the technological advancements that have caught the attention of international trade. According to a report by the Regional Action Group for Africa (2022), "automated cargo tracking drones have the potential to revolutionize international trade." As global trade continues its upward trend, it is becoming increasingly crucial for businesses and governments to ensure the efficient delivery of goods across borders. Automated drones have been implemented successfully in several African countries, including Kenya, Ghana, and South Africa as stated in "Growing Intra-African Trade through Digital Transformation of Border and Customs Services" (p. 11-12). These devices offer an innovative solution that can reduce costs while at the same time improving efficiency and safety standards within supply chains. Moreover, these drones provide real-time monitoring capabilities allowing shippers to track shipments from start till final destination. This will provide better visibility into logistics operations, enabling service providers to make data-driven decisions when managing their fleets. Furthermore, it creates air transportation more sustainable via reduced fuel consumption due to precise route planning leading to the final mile delivery point. In conclusion, Automated Cargo Tracking Drones could be a game-changer in today's global economy with numerous benefits like improved efficiencies; better visibility into logistics operations; cost savings opportunities; and lastly sustainability improvements making it truly appealable initiative towards future development goals for borderless economic growth around the world.

Digital trade platforms have become essential to international business, increasing efficiency and transparency. As stated in the 2021 National Trade Estimate Report on FOREIGN TRADE BARRIERS prepared by the Office of the United States Trade Representative, "digital trade platforms can enhance efficiency and transparency in international business," (USTR, 2021). These platforms allow businesses to streamline their operations by providing a centralized communication and data management location. This creates opportunities for greater

collaboration between companies and easier access to information necessary for successful transactions. Furthermore, digital trade platforms also help reduce costs associated with traditional international business methods such as travel expenses or shipping documents. According to the same report, "substantial information was solicited from U.S. Embassies," (USTR, 2021). With this kind of support behind them, it's clear that digital trade platforms are critical tools for modern enterprises looking to compete globally and improve their bottom line through streamlined processes and transparent practices.

Incorporating new technologies in the transport sector has undoubtedly revolutionized international trade. The introduction of real-time cargo tracking, automated customs clearance, and AI-powered logistics management systems has increased efficiency, reduced delivery times and costs, and improved safety and security. These technological advancements provide a competitive edge to businesses involved in international trade and enable them to penetrate new markets, foster global partnerships and ultimately drive economic growth. However, it is essential to acknowledge that the successful implementation of these technologies requires collaboration and investment from both private and public entities. In this regard, policymakers must take the necessary steps to provide an enabling environment for developing and adopting new transportation technologies.

In conclusion, the modern international business world rapidly evolves with technological advancements. Automated cargo tracking, drones, digital trade platforms, and mobile applications for trade transactions have emerged as game changers in global commerce. These innovations bring fortciency and transparency to international trade by reducing paperwork and delays at ports of entry while increasing security measures. Boosting Efficiency and Transparency: Digital Trade Platforms for International Business summarizes how these platforms can facilitate cross-border trading by eliminating intermediaries between buyers and sellers. This not only makes it more convenient but also reduces transaction costs significantly. Moreover, these platforms provide a secure environment that guarantees authenticity through e-contracts. It's worth noting that electronic customs declarations play an integral role in promoting international trade as they make it easier for businesses to comply with customs regulations globally. They simplify the process of filing information on goods being transported across borders while minimizing errors arising from manual data entry. In conclusion, automated cargo tracking systems work hand-in-hand with drones to reduce lead times during transportation while maintaining a high level of accuracy in transit records; digital trade platforms facilitate frictionless exchange between parties; mobile applications are simplifying

payment processes while enhancing monitoring capabilities; electronic custom declarations improve compliance levels across different jurisdictions. The benefits associated with embracing technology far outweigh the risks involved making it imperative for countries seeking competitive advantage in global markets to embrace automation fully. The future looks bright for businesses venturing into international trading powered by exponential technologies such as AI.

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