Smart Borders: The key to more resilient International Trade and Cross-Border Transportation

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Abstract

The expansion of global transportation and trade has greatly benefited the world economy. However, it has also resulted in significant problems, like security concerns and delays at border crossings. Smart Border initiatives, which use technology and data to facilitate the movement of goods and people across borders while ensuring security, can resolve these issues and create a more resilient international trade and transportation system. This paper makes the case that adopting smart borders can lead to a more effective and safe international trade and transportation system. It analyzes smart borders, discusses their benefits and challenges, and presents case studies of successful smart border initiatives that can be used as models for future initiatives. This study emphasizes the necessity of additional investments in research and development to strengthen the functionality of smart border technologies and the interoperability of various systems and technologies used by multiple countries. The importance of privacy and data protection issues and the requirement for stringent privacy policies and data protection measures are also emphasized in the paper. Finally, the paper proposes Logistechs as a critical component of smart borders to improve logistics, supply chain, and transportation sectors. By focusing on the development and implementation of Logistechs, countries can create a more efficient and secure international trade and transportation system that benefits everyone.

Introduction

International trade and transportation are essential to economic growth in the twenty-first century. The amount of commodities and persons crossing international borders has significantly increased due to the advent of globalization (Ortiz-Ospina 2018). Many advantages have resulted from this progress, including accelerated economic expansion and job creation. However, it has also led to significant challenges, such as increased security concerns and delays at border crossings. These challenges can significantly impact the efficiency of international trade and transportation, leading to decreased economic growth and job creation.

Innovation, technology, and smart infrastructure will shape the future of land ports of entry. Digitalization, automation, technological advances, cybersecurity, data access, and environmental awareness will play a crucial role in securely moving cargo and people across borders (Covarrubias 2021). Exponential technologies such as AI, predictive analytics, robotics, and automation can reduce the costs of handling and inspecting goods and people at land ports of entry (Covarrubias 2021). Optimization models generated through predictive analytics, and AI can minimize wait times while ensuring complete security screening processes.

Smart borders refer to the use of technology and data to facilitate the movement of people and goods across borders while ensuring security. These initiatives include electronic customs systems, automated border control systems, and risk assessment tools {Svitek et al.:2019}. By implementing smart border initiatives, countries can address international trade and transportation challenges and create a more resilient system.

Covarrubias (2021) states that Smart borders have the potential to significantly improve the efficiency and security of international trade and transportation, including at the Land Ports of Entry of the United States. Exponential technologies such as AI, robotics, and automation can

reduce the costs of handling and inspecting goods and people at LPOEs while minimizing border crossing wait times. Further investment in research and development is needed to improve the performance of smart border technologies continuously, and international cooperation and coordination are necessary to enhance the interoperability of different systems and technologies used by different countries.

Many countries have implemented smart border initiatives to address these challenges. These initiatives include electronic customs systems, automated border control systems, and risk assessment tools. By implementing smart border initiatives, countries can address international trade and transportation challenges and create a more resilient system.
This paper will analyze smart borders and their potential to create a more efficient and secure international trade and transportation system. Specifically, we will examine the benefits and challenges of smart borders, present case studies of successful smart border initiatives, propose how Logistechs can improve the efficiency and dependability of international trade and cross-border transportation, and discuss future directions for smart border initiatives.

Benefits and Challenges of Smart Borders

Smart borders offer many benefits for international trade and transportation. First, they can increase the efficiency of border crossings by reducing wait times and processing times. By using automated border control systems, electronic customs systems, and risk assessment tools, smart borders can significantly reduce the time it takes to process goods and people at border crossings (Covarrubias 2022). This increased efficiency can lead to significant cost savings for businesses and individuals.

Second, smart borders can improve security by effectively identifying and targeting high-risk individuals and goods. Smart borders can more accurately and efficiently identify potential security threats using advanced technologies such as biometric identification and risk assessment tools (Martins 2022). This can help prevent the entry of illegal goods or individuals and increase the safety and security of border crossings.

Third, smart borders can reduce costs by decreasing the need for manual processing and increasing automation. By automating many of the processes involved in border crossings, smart borders can significantly reduce the costs associated with manual processing (Covarrubias 2022). This can lead to significant cost savings for businesses and individuals and help make international trade and transportation more accessible and affordable.

Finally, smart borders can improve data collection and analysis, allowing for better decision-making and risk assessment. By collecting and analyzing data on border crossings, smart borders can provide valuable insights into the efficiency and security of international trade and transportation (Covarrubias 2022). This can help governments and businesses make more informed decisions about improving the system and addressing challenges.

However, smart borders also present significant challenges. First, implementing smart border initiatives requires significant investment in technology and infrastructure. Many countries may not have the financial resources or technical expertise to implement smart borders effectively, limiting their ability to participate fully in international trade and transportation.

Second, using technology and data raises concerns about privacy and data protection. Smart borders require collecting and analyzing significant amounts of personal data, raising privacy and data protection concerns. Governments and businesses must ensure that any data collected is used ethically and kept secure to protect the privacy of individuals and businesses.

Finally, implementing smart borders requires international cooperation and coordination, which can take time and effort. Many countries may have different political and economic

interests, making agreeing on a common approach to smart borders challenging. This can lead to delays or limited participation in smart border initiatives, limiting their effectiveness.

Case Studies of Successful Smart Border Initiatives

Several countries have successfully implemented smart border initiatives. For example, the United States has implemented the Automated Commercial Environment (ACE) system, which streamlines the processing of goods through customs. The European Union has implemented the Smart Borders Package, which includes electronic passports and automated border control systems. Singapore has implemented the TradeNet system, which allows for the electronic submission of customs declarations and reduces processing times.

The United States ACE system has been a significant success, processing over 97 percent of all imports and exports. The system has decreased the time it takes to process goods through customs by up to 50 percent, which has led to considerable cost savings for businesses. In order to improve the efficiency of international trade and transportation, US Customs and Border Protection (CBP) developed the Automated Commercial Environment (ACE) system. According to ACE, the time it takes to process products can be reduced by up to 50% by expediting the customs clearance process. Businesses have seen significant cost reductions as a result, and CBP can now handle more than 97 percent of all imports and exports. ACE has also improved data collection and analysis, allowing for better decision-making and risk assessment. The system is continually being updated and improved to meet the changing needs of international trade and transportation.

The Automated Commercial Environment (ACE) system developed by US Customs and Border Protection (CBP) has also successfully increased the effectiveness of global transportation and trade. By streamlining the customs clearance procedure, ACE can save the time it takes to process goods by up to 50%.

The European Union's Smart Borders Package has also been successful, with the system reducing wait times at border crossings by up to 30 percent (EU-LISA 2015). The system has also improved security by allowing more effective identification of potential security threats. The Smart Borders Package is a comprehensive program from the European Union that intends to make the cross-border movement of people and products more effective and secure. The package incorporates automated border control technologies and electronic passports, drastically decreasing wait times at border crossings by up to 30%. Electronic passports include biometric information, such as fingerprints, that automated border control systems can quickly verify, eliminating the need for manual inspections. Automatic border control systems detect people swiftly and correctly using cutting-edge technologies like facial recognition, enabling quicker and more effective processing.

In addition to electronic passports and automated border control systems, the Smart Borders Package includes other initiatives such as trusted traveler programs and pre-screening of passengers. Trusted traveler programs allow for expedited processing of low-risk travelers, reducing wait times and increasing efficiency. Pre-screening of passengers involves collecting and analyzing data on travelers before they arrive at the border, allowing for more effective identification of potential security threats (EU-LISA 2015).

The Smart Borders Package is continually being updated and improved to meet the changing needs of international trade and transportation. The European Union is investing in research and development to improve smart border technologies' performance continuously. The package is also being expanded to include new initiatives such as the use of drones for border surveillance and the integration of customs systems across member states.

Overall, the Smart Borders Package is an important initiative that has dramatically increased the effectiveness and security of cross-border movement within the European Union. The package has enhanced data gathering and analysis, boosted automation, and decreased wait

times, allowing for better decision-making and risk assessment. The package is a crucial part of the European Union's efforts to build a more robust system because it is constantly changing to meet the varying needs of global trade and transportation.

Singapore's TradeNet system has helped firms save considerable money by cutting processing times by up to 90%. Furthermore, the system has improved data collecting and processing, enhancing risk assessment and decision-making.

The TradeNet system in Singapore is an excellent example of how border security measures may dramatically boost the effectiveness of global trade and transportation. The system, which has been used since 1989, is regarded as a ground-breaking project in the industry. The technology is made to make it easier to submit customs declarations and other related papers electronically, expediting the procedure for customs clearance and cutting processing times by up to 90%. This decrease in processing times has allowed businesses to save much money, making it an essential part of Singapore's attempts to build a more effective and safe system (Jr 2021).

The TradeNet system enables the electronic submission of trade documents such as permits, certificates, and cargo manifests, among others. The system also offers a platform for stakeholders to communicate with one another, making the entire trade process more efficient. The system's user-friendly interface makes it easy for businesses to use, and it offers a range of features that enable businesses to manage their trade activities more effectively. For example, the system offers a range of risk assessment and management tools, which helps businesses identify and mitigate potential risks.

Another advantage of the TradeNet system is that it makes it possible to combine various technologies and systems used by various nations, which improves the interoperability of smart border efforts. Through this integration, Singapore may collaborate more closely with its trading partners, facilitating smoother and more effective cross-border trade. The technology also improves data collecting and processing, enabling better risk assessment and decision-making. The trade process can be continuously improved by using this data to spot trends and patterns (Jr 2021).

Overall, the TradeNet system is a prime example of how smart border initiatives can significantly improve the efficiency and security of international trade and transportation. The system's ability to facilitate the electronic submission of customs declarations, risk assessment and management, and integration of different systems and technologies used by different countries, make it a vital component of Singapore's efforts to create a more efficient and secure system. The system's continued evolution and improvement will undoubtedly play a critical role in shaping the future of international trade and transportation.

These case studies demonstrate the potential of smart border initiatives to improve the efficiency and security of international trade and transportation. By implementing smart border initiatives, countries can create a more resilient system that benefits everyone.

LOGISTECHS: A pillar of Smart Borders for International Trade
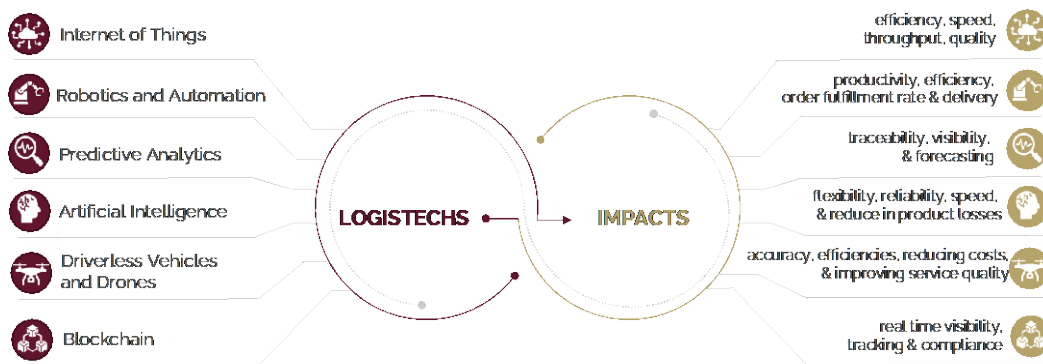
The Fourth Industrial Revolution, also known as Industry 4.0, is changing how businesses operate and the environments in which they participate and compete. This industrial revolution highlights the use of exponential technologies such as blockchain, cybersecurity, data analytics, artificial intelligence (AI), augmented and virtual reality, and the Internet of Things (IoT) (Lom 2016). Industry 4.0 advances the convergence and integration of these digital-based technologies in designing new industrial and supply chain models capable of competing both in flexibility and cost. This accelerated convergence effect is the main reason exponential technologies will significantly impact our lives. This effect occurs when the different technologies grow exponentially, and their growth curves begin to intertwine. These interactions are what allow us to race toward the digital transition (Diamandis 2020).

Logistechs is a concept that has emerged from Industry 4.0. It refers to new advances in the logistics, supply chain, and transportation sectors where exponential technologies play a crucial role. Covarrubias (2021) defines Logistechs as the impact that exponential technologies have on logistics. He classifies them as the exponential technologies that support the transportation of goods, those that improve their handling, and the ones that expedite their customs clearances (figure 1). Logistechs optimize the processes involved across the supply chain, from demand forecasting to route planning. The goal of Logistechs is to achieve greater efficiency and raise the level of customer satisfaction (figure 2).
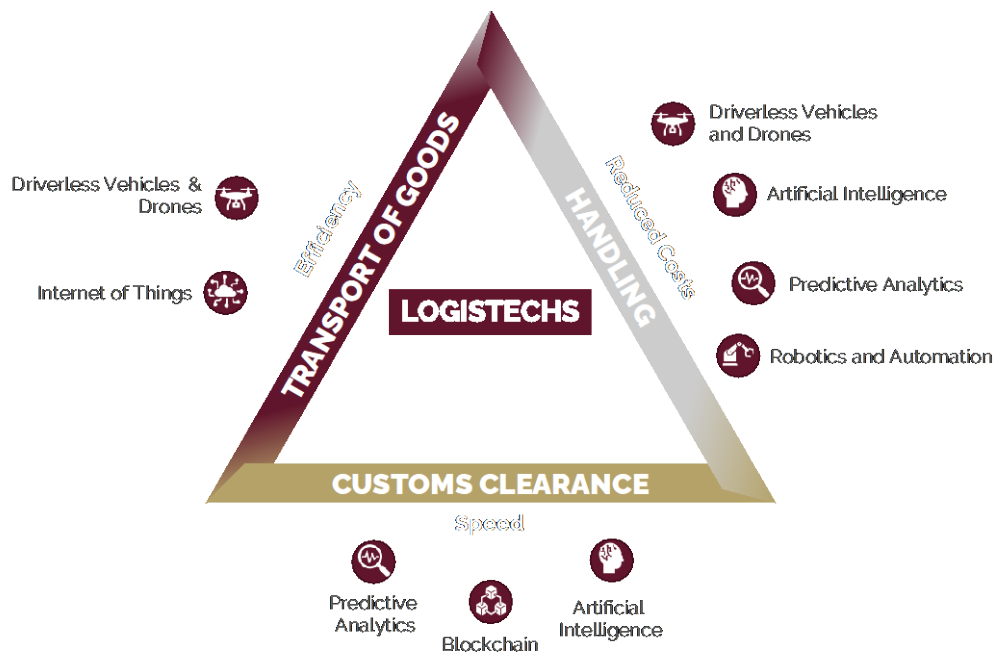
Source: Covarrubias (2021)

However, the current lack of "end-to-end" supply chain cybersecurity, visibility, information traceability, and transparency lead to public and private discoordination, increasing logistics costs, and decreased supply chain resilience (Cedillo-Campos 2022). Speed, competitiveness, productivity, and timing have always been essential in logistics. Today, as supply chains become increasingly complex, with more participants, there are endless documents to verify and lengthy processes to follow. Exponential technologies are vital in handling, treating, and analyzing information, and in managing physical processes. These advances translate into continuous improvement of supply chains. Robots, autonomous vehicles, and the automation of paperwork verification will eliminate the simple and repetitive work scattered throughout logistics processes, leading to a higher quality of service. Big data analytics and artificial intelligence, or AI, will allow companies to analyze their customers' past transactions and shipments, forecast highly accurate demand, and adjust their warehouse spaces and personnel to reduce time-to-market and costs. Cloud computing and machine learning can aid in materials classification, valuation, and tariff compliance. Blockchain has the potential to give businesses and port authorities the global shipment visibility that will improve tracking and compliance in secure, real-time shared ledgers. These digital ledgers can generate total linkages between manifests and invoices, allowing for the supervision of the entire logistics process and data sharing across multiple customs organizations and users.

Internet of Things		efficiency, speed, throughput, quality
Robotics and Automation		productivity, efficiency, order fulfillment rate & delivery
Predictive Analytics		traceability, visibility, & forecasting
Artificial Intelligence	LOGISTECHS → IMPACTS	flexibility, reliability, speed, & reduce in product losses
Driverless Vehicles and Drones		accuracy, efficiencies, reducing costs, & improving service quality
Blockchain		real time visibility, tracking & compliance

For our analysis of how Logistechs can improve the efficiency and dependability of international trade and cross-border transportation for this paper, we will focus on US land ports of entry. According to the US General Services Administration, there are 167 land ports of entry on the United States' borders with Canada and Mexico. Data compiled by the Texas Center for Border Economic and Enterprise Development show that $1 trillion in trade, over 130 million people, 62 million cars, 12.5 million commercial trucks, and 3.5 million railroad cars are processed annually through the United States land ports at its southern and northern borders. By focusing on US land ports of entry, we can identify specific challenges and opportunities for improving the efficiency and security of cross-border transportation and trade.

A significant amount of activity occurs daily at these ports. The Texas Center for Border Economic and Enterprise Development data shows us that annually, in Laredo alone, $250 billion in trade, 7.8 million people, 3 million passenger vehicles, 2.5 million commercial trucks, and 500,000 railroad cars are processed. That's trade equivalent to about $770 per person in the US, and twice the population of Oklahoma coming through one Texas town (Goodman 2023) . Major ports of entry have seen exponential increases through the last 10 years, with Laredo—the most important land port for commercial vehicles—seeing a 60 percent increase in traffic. San Ysidro, a port of entry near San Diego, and the most crucial land crossing for passenger vehicles, is experiencing an increase of about 15 percent. The Eagle Pass entry port in Texas has seen an increase in loaded train containers of 93 percent in the past 10 years.

While the trading world is segmenting into regional markets (Legrain 2020) derived from nearshoring practices, supply chains require less variability in cross-border crossing times to be competitive. Land ports of entry refer to the facilities through which entries or departures, both to and from the United States, of people, vehicles, cargo, and materials occur in a controlled and supervised manner by US Customs and Border Protection, or CBP, and other federal inspection agencies. As such, they are a critical link connecting trade flows stemming from the United States–Mexico–Canada Agreement (USMCA) and are the cornerstones of North America's current and future competitiveness. To improve the effectiveness of supply chains in the USMCA region, land ports of entry must transition from their current state of administrative stopping points to collaborative, binational innovative spaces that will make processes more fluid for cross-border freight flows.

Regrettably, this exponential growth does not always correlate with keeping up with the latest technologies. Two of the big four consulting firms—McKinsey & Company and Deloitte— have identified several challenges for land ports: the increasing complexity of operations, increased pressure for improved security and faster processing, slower adoption of automation versus comparable sectors, and transformation into environmentally cleaner and more efficient facilities (Chu 2018, Berns 2017). Smart infrastructure, innovation, and technological development will shape the land ports of the future, and help them to solve these challenges. Digitalization, automation, technological advances, cybersecurity, data

access, and environmental awareness are changing how we securely move cargo and people across borders.

Considering international trade and cross-border transportation, three leading exponential technologies can produce significant efficiencies: autonomous vehicles, the internet of things and data analytics, and blockchain (Covarrubias 2022,Covarrubias 2021). Autonomous or driverless vehicles have the potential to reduce adverse environmental effects and raise safety standards (Brummelen 2018). They increase transport efficiency because they aren't tied to a human driver's need for breaks. They also autonomously move goods between land port facilities and across international borders, allowing for a complete security screening process. Land ports of entry demand an efficient network of people, computers, and devices, working together to securely clear cargo and people, and to avoid delays.

The internet of things—for example, sensors—permits data to be gathered about transportation and traffic patterns of people, passengers, commercial vehicles, and railroad cars (Ding 2021). These data can then be analyzed, helping produce higher efficiency, speed, throughput, and quality in border crossings. Thus, technologies such as artificial intelligence, or AI, predictive analytics, robotics, and automation could be implemented to reduce the handling costs associated with inspections at ports of entry. As a result, optimization models can be generated using predictive analytics and AI to minimize border crossing wait times, while at the same time increasing screening and security capabilities at ports. Automation and AI enable port security agencies to evaluate travelers and cargo using intelligent sensors that integrate technological advancements in traveler and cargo processing. The use of biometric screening and nonintrusive inspection devices aid agencies in detecting security hazards. Machine-learning algorithms can better anticipate threats and program resources as needed.

Finally, blockchain—together with AI, big data, and predictive analytics—can reshape customs clearance processes at ports of entry (Okazaki 2018). Blockchain increases the traceability of materials within supply chains, improves visibility (Wicker 2022) and compliance, and reduces paperwork and administrative costs by reducing physical inspections. It gives businesses and port authorities global shipment visibility, generating a total linkage between manifests and invoices, allowing for the supervision of the entire logistics process, and for data sharing across multiple customs organizations and users. This exponential technology enhances collaboration between government agencies and corporate entities, expanding opportunities to work jointly to meet new security and efficiency challenges.

Future Directions of Smart Borders

To further improve the effectiveness of smart borders, future attempts should concentrate on strengthening the interoperability of various systems and technologies utilized by various countries. Due to divergent political and economic interests, this will require international coordination and cooperation, which can be difficult. However, cooperation among nations can result in a more streamlined and effective international trade and transportation system.

Smart border initiatives can be improved further by investigating cutting-edge technology like biometrics and blockchain. While blockchain might increase the traceability and transparency of data across borders, biometric identification may offer a more precise and effective method of identifying people. Governments and businesses must also collaborate to overcome obstacles to implementing smart borders, such as high investment costs and worries about data security. The international trade and transportation system can be made more effective, secure, and resilient in the face of new problems by collaborating and investing in new technologies and methods.

More funding for research and development is required to improve the efficacy of smart border technology continually. Countries can stay ahead of new security risks and maintain the efficacy and efficiency of their smart border projects by investing in new technologies and methods.

Logistechs are a vital component of smart borders that refer to the use of exponential technologies such as blockchain, cybersecurity, data analytics, AI, and IoT to improve logistics, supply chain, and transportation sectors. With the advent of Industry 4.0, the use of exponential technologies such as autonomous vehicles, the internet of things and data analytics, and blockchain can produce significant efficiencies in international trade and cross-border transportation. For example, autonomous vehicles can reduce adverse environmental effects and raise safety standards while increasing transport efficiency by allowing for complete security screening processes. The internet of things can permit data to be gathered about transportation and traffic patterns, allowing for higher efficiency, speed, throughput, and quality in border crossings. Finally, blockchain can reshape customs clearance processes at ports of entry by increasing traceability, improving visibility and compliance, and reducing paperwork and administrative costs. By focusing on the development and implementation of Logistechs, countries can create a more efficient and secure international trade and transportation system that benefits everyone.

In order to continuously improve the performance of smart border technology, further research and development funding is required. Countries may stay ahead of new security risks by putting money into innovative technology and methods while also making sure that their efforts to build smart borders continue to be successful.

Finally, businesses and governments must collaborate to address privacy and data protection concerns. Firms and governments may guarantee that the personal data obtained through smart border initiatives is utilized responsibly and kept secure by putting in place strict privacy policies and data protection procedures.

Conclusion

The expansion of international trade and transportation has benefited the world economy significantly and created substantial problems like border crossing delays and security worries. Initiatives for "smart borders" can deal with these difficulties and build a more durable global trade and transportation network by facilitating the movement of people and products across borders while maintaining security.

Smart border implementation has various advantages, including increased productivity, enhanced security, lower costs, and better data gathering and analysis. Nevertheless, it also poses critical obstacles, including the necessity for a sizable investment, worries about data security and privacy, and the requirement for global coordination and cooperation. Effective smart border programs like the ACE system in the US, the Smart Borders Package in the EU, and the TradeNet system in Singapore have shown how smart borders may dramatically boost the effectiveness and security of global trade and transportation.

Logistechs, which refer to the use of exponential technologies such as blockchain, cybersecurity, data analytics, AI, and IoT to improve logistics, supply chain, and transportation sectors, are vital components of smart borders. By focusing on US land ports of entry, we can identify specific challenges and opportunities for improving cross-border transportation and trade efficiency and security.

Future initiatives should include improving the interoperability of the many systems and technologies employed by various nations, increasing research and development spending, and resolving privacy and data protection issues. By solving these issues, nations may develop an all-encompassing system of international trade and transportation that is more effective and secure.

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