Working Paper 2024.1.6.2
- Vol 1, No 6

VẬN TẢI ĐA PHƯƠNG THỨC HƯỚNG TỚI PHÁT TRIỂN BỀN VỮNG: NGHIÊN CỨU TRƯỜNG HỢP VỀ DỊCH VỤ ĐƯỜNG BIỂN - HÀNG KHÔNG CỦA DHL TỪ TRUNG QUỐC ĐẾN CHÂU ÂU

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Tóm tắt

Trong bối cảnh nhận thức về môi trường đang gia tăng mạnh mẽ trên toàn thế giới, mối quan hệ giữa phát triển bền vững và vận tải đa phương thức đóng một vai trò quan trọng. Báo cáo này tập trung vào việc phân tích chi tiết trường hợp Dịch vụ đường biển - hàng không của DHL từ Trung Quốc đến Châu Âu. Dựa trên nền tảng lý thuyết về phát triển bền vững, nghiên cứu này phân tích kỹ các chi tiết vận hành của Dịch vụ đường biển - hàng không của DHL Global Forwarding, tập trung vào các khía cạnh như chi tiết lộ trình, chiến lược chuyển đổi phương thức, hiệu suất dịch vụ và khả năng thích ứng với thị trường. Bên cạnh đó, báo cáo hướng sự chú ý đến tác động môi trường và kinh tế - xã hội rộng lớn hơn, với sự đóng góp chủ chốt của DHL trong hành trình logistics bền vững. Phần đánh giá tập trung phân tích những lợi ích tiềm năng về môi trường và kinh tế của Dịch vụ đường biển - hàng không mang lại và đo lường phản ứng

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của thị trường, đồng thời thừa nhận một cách minh bạch những hạn chế hiện có. Báo cáo kết thúc bằng việc đưa ra các khuyến nghị quan trọng cho DHL Global Forwarding để đạt được mục tiêu phát triển bền vững trong tương lai.

Từ khoá: Phát triển bền vững, vận tải đa phương thức, DHL Global Forwarding, dịch vụ đường biển - hàng không.

MULTIMODAL TRANSPORTATION TOWARDS SUSTAINABLE DEVELOPMENT: A CASE STUDY OF DHL'S SEA-AIR SERVICE FROM CHINA TO EUROPE

Abstract

In an age characterized by heightened global environmental awareness, the intricate relationship between sustainable development and multimodal transportation assumes a pivotal role. This report focuses specifically on the detailed analysis of DHL's Sea-Air Service from China to Europe. Embedded within the theoretical framework of sustainable development, the study critically dissects the operational intricacies of DHL Global Forwarding's Sea-Air Service, exploring aspects such as route specifics, mode transition strategies, service performance, and adaptability to dynamic market forces. Expanding beyond traditional logistical considerations, the report directs attention to the broader environmental and socio-economic impact, positioning DHL as a central player in the unfolding narrative of sustainable logistics. The evaluation phase systematically assesses the Sea-Air Service's potential environmental and economic benefits, gauging customer satisfaction and market response while transparently acknowledging any existing limitations. The report concludes by presenting key recommendations for DHL Global Forwarding to achieve future sustainable development.

Key words: Sustainable development, Multimodal transportation, DHL Global Forwarding, Sea-Air Service.

1. Introduction

In the context of worldwide trade and logistics, the growing emphasis on sustainable development has spotlighted the crucial role played by multimodal transportation systems. As a visionary and forward-looking development paradigm, sustainable development hinges on harmonizing economic, social, and environmental factors. This integration is crucial for the well-being of individuals and societies, with multimodal transportation emerging as a key enabler in achieving this delicate balance.

Extensive research has underscored the multifaceted impact of multimodal transportation on sustainable development, specifically examining its implications on the environment, economy, and society. Evaluating the efficiency and environmental footprint of various transportation modes is crucial for informed decision-making. In the pursuit of sustainable development, the economic and social dimensions of multimodal transportation play a pivotal role.

2. Research Gap

The DHL Sea-Air Service from China to Europe merits distinctive attention due to its unique combination of maritime and aerial transportation. Unlike conventional single-mode routes, this hybrid approach capitalizes on the strengths of both modes, optimizing cost-effectiveness and delivery speed. The sea leg allows for bulk transportation, reducing costs, while the air leg expedites the overall shipping process. This integration of modes minimizes environmental impact compared to solely air transport, making it a noteworthy case for sustainable multimodal transportation. The route's strategic adaptability to market dynamics further enhances its significance, showcasing a comprehensive and resilient model in the context of global trade and logistics.

However, there exists a gap in comprehensively analyzing specific case studies that epitomize the principles of sustainable multimodal transportation. This research aims to bridge this gap by undertaking a critical analysis of DHL's Sea-Air Service from China to Europe. Examining route details, mode transition strategies, service performance, and adaptability to market dynamics, this study seeks to unearth the potential environmental and economic benefits of DHL's approach. Furthermore, it evaluates customer satisfaction, market response, and acknowledges any remaining limitations. By doing so, the study aims to offer tailored recommendations for DHL Global Forwarding to enhance its future sustainable development strategies in the realm of multimodal transportation.

3. Theoretical framework

3.1. Defining the sustainable development concept

While the fundamental idea of sustainable development is apparent, there have been robust discussions surrounding the precise interpretation of this concept. The first definition of sustainable development surfaced in a 1987 United Nations report titled "*Our Common Future*" which is now generally referred to as the Brundtland Report of the World commission on Environment and Development 1987. It defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). Also, the National Sustainable Development Strategy defines sustainable development as a targeted, long-term, comprehensive and synergic process that:

(i) affects the conditions and all aspects of life at all levels,

(ii) satisfies the biological, material, spiritual and social needs and interests of people,

(iii) eliminates or significantly reduces interference that endangers, damages or destroys conditions and forms of life,

(iv) does not burden the country,

(v) preserve resources and

(vi) protects cultural and natural heritage.

In the academic literature, sustainable development is defined as the process of improving the quality of human life while living within the carrying capacity of supporting ecosystems. (Willers, 1994). According to Diesendorf (2000), sustainability is the goal or endpoint of a process called sustainable development. Gray (2010) reinforces the point by arguing that, while "sustainability" refers to a state, sustainable development refers to the process for achieving this state.

In this report, sustainable development is considered an effort at guaranteeing a balance among economic growth, environmental integrity and social well-being. It is a dynamic process in which communities anticipate and accommodate the needs of current and future generations in ways that reproduce and balance local social, economic, and ecological systems, and link local actions to global concerns.

3.2. Pillars of sustainable development

As a visionary and forward-looking development paradigm, sustainable development emphasizes a positive trajectory anchored essentially on social, economic and environmental factors. As a result, it is crucial to harmonize three core elements in order to achieve sustainable development: economic sustainability, social sustainability, and environmental sustainability. These elements are interconnected and are all crucial for the well-being of individuals and societies.

3.2.1. Economic sustainability

Economic sustainability implies a system of production that satisfies present consumption levels without compromising future needs (Lobo, Pietriga, & Appert, 2015). This pillar is based on companies' ability to contribute to economic development and growth. In other words, they must encourage and promote the protection of the environment by limiting the risks posed by their production.

The growing scale of the economic system has overstretched the natural resource base, prompting a rethink of the traditional economic postulations. This recognition has led to a paradigm shift in economic thought, with increasing focus on sustainable development strategies. Balancing economic growth with environmental preservation is now seen as imperative for long-term prosperity.

Achieving economic sustainability involves various factors. First, it's crucial to manage resources responsibly, using them wisely without jeopardizing future needs. Economic systems and businesses also need to be efficient and innovative to adapt to changing circumstances. Macro-level financial stability is essential for overall economic health. Social innovation at the country level, addressing issues like poverty, gender equality, education, healthcare, and the environment, plays a significant role. International cooperation, especially partnerships between public and private sectors, strengthens global economic resilience. Additionally, promoting fairness,

inclusivity, and corporate responsibility are vital elements in building a sustainable economic framework.

3.2.2. Social sustainability

Social sustainability encompasses notions of equity, empowerment, accessibility, participation, cultural identity and institutional stability (Daly, 1992). The social pillar of a company's sustainable development refers to values that promote equality and respect for individual rights. In Saith's (2006) opinion, at the social level sustainability entails fostering the development of people, communities and cultures to help achieve meaningful life.

Social sustainability places a central emphasis on cultivating inclusive societies, diminishing inequality, and securing long-term welfare for all, while upholding social cohesion and justice (United Nations, 2020). To attain social sustainability, formidable challenges must be addressed, encompassing the alleviation of poverty and socioeconomic disparities, combating discrimination and social exclusion, ensuring access to vital resources, and addressing local, regional, and global insecurities and conflicts. Moreover, tackling poor governance, encompassing issues like corruption and institutional inefficiency, is imperative in fostering a sustainable social landscape.

In the pursuit of social sustainability, pivotal efforts involve the promotion of systems and policies geared towards mitigating social and economic inequalities (World Economic Forum, 2022). Beyond the fight against inequality, key objectives in the realm of social sustainability include advocating for policies that uphold basic human rights, embracing practices that value diversity in terms of backgrounds, gender, ethnicity, ability, and sexual orientation, creating safer living environments through efficient administration of justice, and enhancing overall health and well-being through the provision of quality healthcare services.

3.2.3. Environmental sustainability

Environmental sustainability relates to ecosystem integrity and carrying capacity of the natural environment (Brodhag & Taliere, 2006). It requires that natural capital be sustainably used as a source of economic inputs and as a sink for waste (Goodland & Daly, 1996).

Environmental sustainability is the ongoing effort to preserve the natural environment over time while meeting current needs and ensuring resources for the future. Key factors influencing environmental sustainability include pollution of air, water, and soil, climate change due to excessive greenhouse gas emissions, loss of biodiversity, overexploitation of natural resources, and unsustainable economic models. Additionally, there's a focus on increasing renewable energy use, implementing biodiversity conservation policies, adopting sustainable agricultural practices, reducing food waste, raising awareness, and promoting a circular economy.

Central to sustainability efforts is the conservation and sustainable management of natural resources such as water, soil, forests, wildlife, and habitats, ensuring the ecological balance and resource availability for future generations. Embracing precision agriculture, regenerative

agriculture, agrivoltaics, and addressing food waste through technology and awareness campaigns are critical components of sustainable practices in agriculture and the food chain. Integrating these goals and practices is fundamental in addressing the multifaceted challenges and advancing the cause of environmental sustainability on a global scale.

3.3. Multimodal transportation toward sustainable development

3.3.1. Overview of multimodal transportation

According to the European Commission, "multimodal transport" refers to the use of many modes (or methods) of transportation within the same trip. This approach applies to both freight and passenger transit (European Commission, 2018). To meet future mobility demands, physical infrastructure, transportation systems, traffic management, operational procedures, and information systems will be fully linked.

In a specific example, e-commerce pioneer Amazon incorporates air, road, and train transportation into its extensive logistical network. Its capacity to promise and fulfill two-day or even same-day delivery across several locations is due to its well-coordinated multimodal transportation infrastructure and modes of transportation.

3.3.2. The role of multimodal transportation towards sustainable development

There has been a lot of research on the role of multimodal transportation in sustainable development, with three major aspects: the environment, the economy, and society. When completely implemented, the multimodal transportation network should reduce traffic congestion and carbon emissions, making the entire sector safer and more cost-effective. Ultimately, multimodality is projected to help develop a sustainable and integrated transportation system (European Commission, 2018).

Environmental impact:

Reduction of traffic congestion and pollution through efficient logistics processes: Lin (2019) examines the environmental impact of a Swedish trading corporation importing items from China and distributing them to Scandinavian and European markets using multimodal transport. In this situation, small vehicles collect consignments from Chinese producers and bring them to collecting centers, where the commodities are transferred to large trucks and carried to consolidation facilities, where they are further loaded into containerized transport units. This method of collecting, transhipment, and transportation to loading centers decreases traffic congestion and pollution. Shipments placed in containers at consolidation centers are transferred by trucks to loading terminals at the harbor, where they are loaded onto ships and delivered to their final destination. When the cargo ship arrives, the containers are moved to rail transport and delivered to an intermodal terminal and warehouse. At this facility, goods are loaded onto road trucks for last-mile delivery to the needed trade stations (Lin, 2019).

Environmental benefits of multimodal transportation over road transportation: How current developments impact the function and growth of multimodal road-rail transport, particularly in

Scandinavia has been investigated by Bergqvist and Floden in 2010. They focused primarily on the environmental aspect of sustainability and found that employing multimodal transportation rather than road transportation would significantly cut CO2 emissions in Sweden.

Improvements in environmental performance and reduction in harmful impacts of using multimodal transport for risky commodities compared to individual vehicle delivery: According to Lomotko et al. (2023), while researching intermodal transport, the use of multimodal transport for risky commodities has a beneficial environmental impact when compared to individual vehicle delivery. The study revealed that replacing single-modal road transport with multimodal modes like rail, sea, and river transport can improve environmental performance, reduce the number of flights, and minimize harmful environmental impact.

Economical and Social

Role of multimodal transportation in transitioning to a carbon-neutral economy, attracting investment, and enhancing consumer trust: According to Datsii et al. (2021), multimodal transportation is critical for a successful transition to a carbon-neutral economy. Investing in the development of multimodal transportation can help countries obtain high sustainability ratings, attracting investment and increasing consumer trust. Article by Yonglei Jiang et al., 2020 discusses the impact of the new international land-sea trade corridor, which was jointly built by China's western provinces and ASEAN countries, on freight transport structures and makes related proposals for the development of international logistics service providers. The corridor is viewed as a significant component in regional economic growth in light of increased international economic cooperation and the fast expansion of the global transportation system.

The need for government intervention to manage sustainability aspects effectively: Another study by Tamannaei et al. (2021) reported on the economic and social sustainability components. Governments often increase sustainability dimensions in freight transportation by levying fees on transportation networks. As a result, they should broaden their understanding of the relationships between sustainability aspects and how their interventions impact each dimension. A sequential game is used to investigate duopoly competition. A government, as a Stackelberg leader, levies fuel-related tariffs based on environmental, economic, and social considerations. At a lower level, a Nash game is created to examine pricing competitiveness in the transportation industry. Their studies demonstrate that transport policy must be controlled.

A multimodal transport development model has been introduced by Aldona et al. (2023) to illustrate how dimensions of sustainability can be reached.

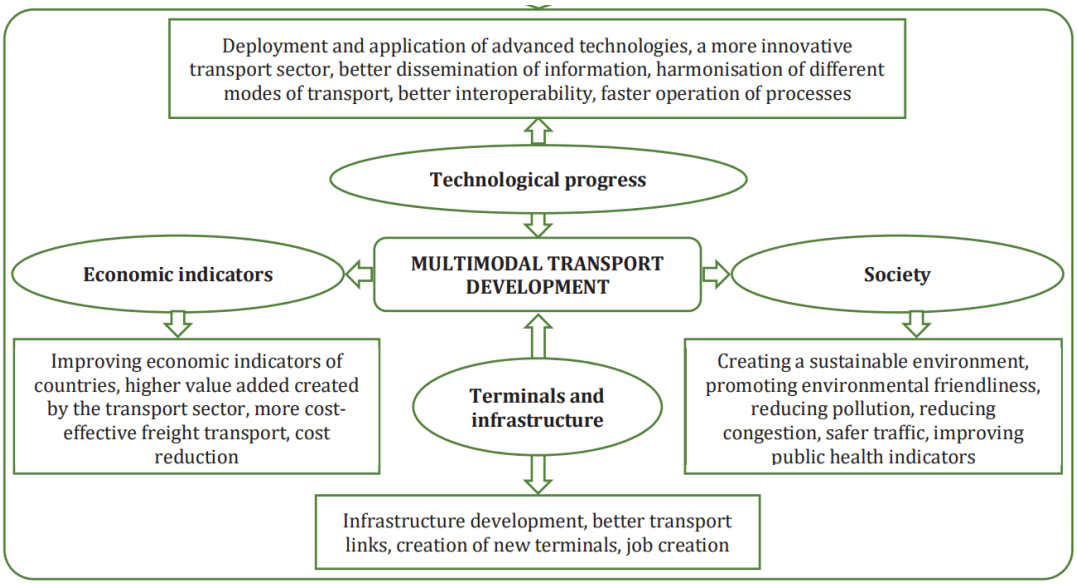

Figure 1. Motimodal transport development model

Source: Aldona et al. (2023)

As described in Figure 1, to fully realize the potential of multimodal transportation, companies must be pushed to adopt it as a way to reduce negative environmental aspects by political, social, and economic measures such as tax breaks and subsidies. This concept would allow for the establishment of a multimodal transport network, whose operation would significantly contribute to the building of a greener, more sustainable, efficient, and economically advantageous environment for the transportation industry.

4. Critical Analysis of DHL's Sea-Air Service from China to Europe

4.1. Overview of DHL Global Forwarding

4.1.1. History development

DHL is an international express delivery company established in 1969 by Adrian Dalsey, Larry Hillblom, and Robert Lynn and the founders' initials D, H & L are used to name the company DHL Express, operating in more than 50 countries. Its headquarter is located in Bonn, Germany.

Since 1998, Deutsche Post, a German company, began buying shares of DHL and completed the acquisition in 2002. DHL is a division of the world's leading postal and logistics company Deutsche Post DHL Group providing logistics services with a series of branches in many countries around the world. DHL dominates the European and Asia-Pacific markets, overall, DHL is the largest provider, with 38 percent of the consolidated global market (stated by Statista, 2022).

DHL's business units include:

- Post and Paket Deutschland
- DHL Express
- DHL Global Forwarding
- DHL Freight
- DHL Supply Chain
- DHL eCommerce

DHL Global Forwarding, formerly known as DHL Danzas Air & Ocean, provides global forwarding services using many diverse forms of transport: air transport, sea transport, road transport, railway transport,... and especially same-day transport. It also plans and undertakes major logistics projects under the brand name DHL Industrial Projects. Together with DHL Freight, it forms Deutsche Post's Freight/ Forwarding department.

4.1.2. Services

The Forwarding division carries goods by rail, road, air and sea under the DHL brand and includes the DHL Freight operation which runs a ground-based freight network covering Europe, Russia and traffic into the Middle East.

Launched in early 2019, DHL's multimodal solution serves more than 300 customers, shipping to 50 destinations with more than 5 million kilos shipped. DHL Global Forwarding's multimodal solutions mix the agility of air transportation, the adaptability of dedicated inland solutions, and the cost-consciousness and de-carbonization of ocean shipping. Some routes recently available include: SeaAir from Asia (available from more than 25 origins in Asia, routes to Europe, Central and Latin America, every route covered at least once a week, Multimodal Express), …

4.2. The operation of DHL's Sea-Air Service from China to Europe

4.2.1. Route details and key transit points

Experts are divided on whether China is still the "workbench of the world". Nonetheless, China manufactures a large number of items for the European market, such as microelectronics and forklifts. This implies that logistics between China and Europe are in great demand.

DHL provides multimodal transportation services, including a sea-air route from China to Europe. The freight will be transported from Asia's port of departure through Dubai and then onto pre-booked air cargo space to be flown into Europe, the Middle East, and Africa.

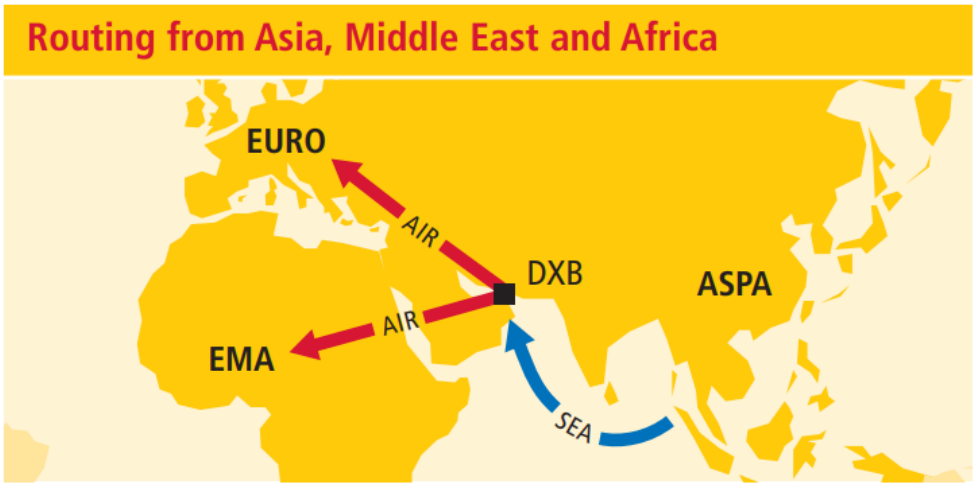

Figure 2. Routing From Asia to Europe, Middle East and Africa

Source: www.dhl.com

For more urgent freight destined to Europe, DHL Global Forwarding offers an expedited service. Freight collected in Asia will initially be forwarded through Incheon, S. Korea, then flown directly into Europe.

Figure 3. Expedited routing from Asia to Europe

Source: www.dhl.com

4.2.2. Mode transition strategies and synchronization

DHL's multimodal logistics solution is characterized by its flexibility and ability to strategically choose transportation modes for the secure and timely delivery of goods from distant sources. This solution offers a comprehensive range of transportation modes, including air, ocean, road, and rail, particularly for routes from Asia to the European Union (EU). The selection of these modes is based on a meticulous analysis of factors such as cost, transit time, potential risk, and ecological impact (DHL, 2021). In the context of inbound delivery for retail and fashion freight,

DHL's multimodal solution maintains a best-fit mode selection, presenting a thorough evaluation of the pros and cons associated with air, ocean, and, specifically for Asia-EU routes, road and rail. The flexibility extends to the combination of various modes, facilitating a dynamic approach, all under a single door-to-door rate structure. By blending the agility of air transportation, the adaptability of dedicated inland solutions, and the cost-consciousness and de-carbonization focus of ocean shipping, DHL's multimodal solutions offer both Less than Container Load (LCL) and Full Container Load (FCL) options (Zeng Xin, 2022). This analytical approach ensures a nuanced understanding of the diverse factors influencing mode selection and underscores DHL's commitment to providing tailored, efficient, and environmentally conscious logistics solutions.

Moreover, leveraging big data is integral to ensuring seamless synchronization and real-time communication across diverse transport modes in the logistics sector. Martin Wegner, Vice President Research & Development at DHL Customer Solutions & Innovation, aptly notes the symbiotic relationship between big data and logistics, emphasizing the immense potential it holds for innovative business models (Pierce, 2020). By meticulously recording specific details of millions of daily deliveries, including destination, size, weight, and contents, logistics companies can evolve into comprehensive search engines, catering to diverse user needs. For instance, correlating weather conditions, flu outbreaks, and consumer online purchases through big data analysis enables logistics providers, such as DHL, to maximize service efficiency by synchronizing the valuable real-time data. This forward-thinking approach, exemplified by DHL's pioneering stance, not only aligns with industry trends but underscores a commitment to integrating advanced technology for an enhanced customer experience (DHL, 2020a). This integration of big data in logistics aligns with sustainable development goals by enhancing operational efficiency. By leveraging real-time data for optimized route planning and resource utilization, logistics companies can reduce fuel consumption and emissions, contributing to environmental sustainability. Additionally, the use of big data enables more accurate demand forecasting, minimizing unnecessary transportation and storage, thus promoting resource conservation and minimizing environmental impact. This approach reflects a commitment to both technological innovation and environmentally conscious practices within the logistics sector.

Implementing dynamic routing optimization algorithms tailored to DHL's sea-air services is also crucial for achieving cost efficiency, timeliness synchronization, and alignment with sustainability goals. One notable initiative in this realm is spearheaded by Greenplan, a DHL-financed startup dedicated to sustainable logistics (DHL, 2020b). Greenplan's route optimization algorithm not only reduces operational costs but also diminishes the environmental impact of deliveries. The tool enhances prediction accuracy for estimated arrival times, facilitates time window arrangements, and provides priority handling services for critical shipments. Prioritizing factors such as minimizing mileage, fuel consumption, and driving hours, while maximizing driver productivity and vehicle utilization, the algorithm aligns seamlessly with DHL's commitment to sustainability. Beyond operational advantages, Greenplan's algorithm actively contributes to the reduction of carbon dioxide emissions and the overall environmental footprint of delivery vehicles. The tool's efficiency is further underscored by its rapid and flexible updates, requiring 70% less

computing time compared to standard tools (Wilson, 2020). Recognizing its contributions, Greenplan received the prestigious PostEurop Innovation Award, affirming its dedication to driving sustainability in logistics and its potential to contribute significantly to climate goals (Norman, 2020).

4.2.3. Service Performance

DHL Global Forwarding strategically utilizes its robust visibility platform, accessible through mydhli.com, to deliver real-time tracking and status updates, providing customers with a transparent and streamlined experience. The platform serves as a cornerstone in DHL's commitment to customer-centric logistics solutions. Through continuous enhancement, DHL augments the platform with features designed to provide customers with comprehensive insights into mode transitions and precise expected delivery timelines. This analytical approach ensures that the platform not only meets the fundamental need for real-time tracking but also caters to the broader demand for detailed information regarding the journey of shipments. By fostering a seamless integration of data and technology, DHL Global Forwarding exemplifies its dedication to delivering reliable and insightful visibility solutions, reinforcing its position as a leader in the logistics industry. DHL Global Forwarding's emphasis on real-time tracking and transparent logistics aligns with sustainable development by promoting resource efficiency. The ability to provide customers with precise delivery timelines and comprehensive insights into shipment journeys helps optimize routes, minimize delays, and reduce unnecessary resource consumption. This commitment to technological solutions enhances operational efficiency, contributing to a more sustainable logistics ecosystem. By prioritizing visibility and streamlining processes, DHL Global Forwarding contributes to a more resource-conscious and environmentally friendly approach within the logistics industry.

Proactive issue resolution strategy, integrating predictive analytics and artificial intelligence are also key elements within DHL's service ecosystem. This analytical approach allows for the identification of potential issues before they exert any adverse impact on performance. By leveraging advanced technologies, DHL enhances its operational foresight, ensuring a proactive stance in addressing challenges (DeNittis, 2023). Complementing this predictive capability is the implementation of strategic communication protocols. DHL prioritizes keeping customers well-informed about any deviations from the original service plan, as stated in its goal of delivering customer service excellence (Torres, 2014). This commitment to proactive communication is designed to foster transparency, manage expectations, and provide customers with timely updates. Through the seamless integration of predictive analytics and strategic communication, DHL Global Forwarding showcases a methodical and customer-focused approach to issue resolution, underscoring its dedication to delivering a reliable and responsive logistics service. This approach helps prevent disruptions and minimizes the environmental impact associated with unforeseen challenges in logistics operations. Moreover, the commitment to strategic communication enhances transparency and allows customers to make informed decisions, contributing to a more sustainable and customer-centric logistics ecosystem. By leveraging advanced technologies and

emphasizing proactive strategies, DHL Global Forwarding showcases a methodical and environmentally conscious approach to issue resolution within the logistics industry.

The company also demonstrates a commitment to customer-centric communication by establishing tailored channels that align with its core values of transparency and customer satisfaction. In the event of service disruptions or delays, the company employs proactively digitized communication strategies to keep customers well-informed about any deviations from the original service plan (Scharwath, 2022). This approach is rooted in the provision of clear and timely notifications, coupled with presenting alternative solutions. By implementing these strategies, DHL Global Forwarding ensures that customers receive comprehensive information, enabling them to make informed decisions amid unforeseen circumstances. This commitment to transparent and proactive communication not only aligns with industry best practices but also underscores DHL Global Forwarding's dedication to maintaining high standards of service and responsiveness in the logistics sector.

4.2.4. Adaptability to Market Dynamics

DHL Global Forwarding employs agile logistics planning strategies to facilitate rapid adjustments in response to dynamic market shifts (Havarangsi, 2018). This analytical approach is embedded in the company's commitment to staying responsive to evolving industry conditions. Leveraging the extensive global network and expertise of DHL, the company actively anticipates market dynamics and proactively adjusts transportation strategies accordingly. By staying at the forefront of emerging trends and leveraging a wealth of industry knowledge, DHL positions itself to swiftly adapt to changes in market demands, geopolitical factors, and economic conditions. This strategic agility not only enables DHL Global Forwarding to maintain operational resilience but also underscores its capacity to provide adaptive and efficient logistics solutions, thereby reinforcing its position as a leader in the global logistics landscape. This strategic agility is not merely a demonstration of operational resilience; rather, it manifests as a sophisticated and calculated response to the imperatives of sustainability. DHL’s agile logistics planning minimizes inefficiencies and resource utilization, thereby reducing its environmental footprint. In this formalized strategic acumen, DHL emerges not merely as a logistics provider but also an adaptive and efficient problem-solver, solidifying its preeminence in the global logistics trend.

Within the logistics industry, DHL also maintains a commitment to staying at the forefront of technological advancements. This involves a strategic incorporation of innovations that align with the company's overarching goals. By actively monitoring and adopting emerging technologies, DHL ensures that its operations remain efficient, scalable, and in tune with the evolving needs of the logistics landscape. Furthermore, the company places a significant emphasis on utilizing data analytics, predictive analytics, and artificial intelligence as crucial tools for gaining market insights. This analytical approach supports informed decision-making and enhances the company's overall adaptability. Through the integration of advanced technologies and data-driven insights, DHL Global Forwarding not only remains competitive in a rapidly evolving industry but also solidifies its position as a leader, adept at navigating the complexities of the modern logistics

landscape. This proactive approach to adopting emerging technologies ensures scalability, reflecting a commitment to long-term sustainability. By staying in tune with evolving logistics needs through technology integration, the company positions itself as a leader capable of navigating the complexities of the modern logistics landscape while minimizing its ecological footprint. In essence, DHL's technological investments contribute to a more sustainable and adaptive future for the logistics industry.

Finally, continuous workforce training is strategically prioritized as an investment in the development of DHL's logistics personnel (DHL, 2023). This commitment is grounded in the recognition that in-depth skills are essential for navigating the intricacies of dynamic market conditions. By providing ongoing training programs, DHL ensures that its personnel stay abreast of industry advancements and acquire the expertise needed to address evolving challenges effectively. Concurrently, the company fosters a culture of adaptability and continuous improvement within the DHL Global Forwarding team. This cultural emphasis promotes a mindset of flexibility, innovation, and a commitment to consistently enhancing operational processes. Through these initiatives, DHL not only equips its workforce with the necessary skills but also instills a proactive and adaptive ethos, reinforcing the company's resilience and competitiveness in the logistics sector. This commitment to continuous workforce training aligns with sustainable development by ensuring skilled personnel navigate dynamic market conditions. Ongoing training enhances operational efficiency, minimizing errors, and optimizing resource use. This not only supports environmental sustainability by reducing waste but also fosters a culture of adaptability and innovation, reinforcing DHL's resilience and competitiveness in the evolving logistics sector.

5. Evaluation of DHL's Sea-Air Service from China to Europe

5.1. Achievements

Potential environmental benefits

DHL's sea-air service from China to Europe has the potential to provide a service that is faster than pure ocean freight and more economical than standard air freight. According to the company, the service is 30% to 50% faster than pure ocean transport and offers a cost savings of up to 60% over pure air shipping. Air transport is known for its substantial carbon footprint, and by incorporating a sea leg into the journey, DHL aims to mitigate the environmental impact. The slower but more fuel-efficient sea freight segment of the service contributes to a reduction in greenhouse gas emissions, making Sea-Air a more environmentally responsible option for long-distance shipments.

Furthermore, the Sea-Air Service aligns with global efforts to promote modal shift and optimize transportation routes for increased energy efficiency. Leveraging the advantages of both sea and air transportation, DHL's service optimizes the energy-intensive air freight component, while benefiting from the fuel efficiency of sea transport during the oceanic leg. This strategic integration demonstrates a commitment to minimizing the ecological footprint of freight

operations. The potential reduction in air traffic associated with the Sea-Air Service also contributes to lower levels of air pollution. Air freight is known for its impact on local air quality due to emissions released during takeoff and landing (Yifang et al, 2011). By diverting a portion of the cargo volume to sea transport, DHL's Sea-Air Service has the potential to relieve the environmental burden on regions surrounding major airports, offering a dual advantage of reduced pollution and noise levels.

In addition to the immediate environmental benefits, the Sea-Air Service may contribute to a broader shift in industry practices towards sustainability. As consumers and businesses increasingly prioritize environmentally responsible supply chain practices, DHL's commitment to offering a Sea-Air option reflects a proactive approach to meeting these demands. The integration of sustainability into logistics operations not only aligns with corporate social responsibility goals but also positions DHL as a leader in environmentally conscious freight solutions.

Economic benefits

One primary economic benefit of the Sea-Air Service is its ability to offer a competitive advantage in terms of cost-effectiveness. By strategically combining the cost-efficient sea freight with the speed of air transport, DHL aims to provide businesses with a viable alternative to traditional shipping methods. The optimization of transportation costs, while maintaining a reasonable transit time, contributes to enhanced cost predictability and competitiveness for businesses engaged in cross-continental trade between China and Europe.

The Sea-Air Service also addresses the growing demand for flexible logistics solutions in a dynamic global market. The integrated nature of DHL's service allows businesses to tailor their transportation choices based on specific needs, offering a versatile and responsive approach to the challenges of modern supply chain management. This flexibility is particularly valuable for industries with fluctuating demand patterns, enabling companies to adapt their shipping strategies in response to market changes efficiently.

Furthermore, the Sea-Air Service fosters a more interconnected global economy by providing businesses with a reliable and efficient means of transporting time-sensitive goods. As trade volumes between China and Europe continue to grow, the enhanced connectivity offered by DHL's service contributes to strengthen economic ties, encouraging the development of new markets and trade relationships. This increased connectivity has the potential to unlock economic growth opportunities for businesses across diverse sectors.

5.3. Challenges

Despite the notable advantages and innovative features of DHL's Sea-Air Service connecting China to Europe, it is essential to acknowledge the remaining limitations that may impact its widespread adoption and effectiveness in certain contexts.

The complexity of multimodal transportation

One significant limitation lies in the inherent complexity of multimodal transportation. While the Sea-Air Service aims to seamlessly integrate sea and air transport, the intricacies of coordinating these modes can result in logistical challenges. Factors such as varying transit times between sea and air segments, potential disruptions in the transfer process, and the need for efficient intermodal handling may contribute to operational complexities, affecting the overall reliability of the service. Another crucial aspect is the dependency on specific geographical and infrastructural considerations. The success of DHL's Sea-Air Service is contingent upon the availability and efficiency of maritime and air transportation infrastructure along the route from China to Europe. In regions with underdeveloped or strained transportation networks, the service may face limitations in terms of operational efficiency and may not be as viable compared to regions with well-established logistics infrastructure.

Constraints in operation

The potential for geopolitical disruptions and regulatory constraints introduces a layer of uncertainty. Given the international nature of the Sea-Air Service, changes in trade policies, geopolitical tensions, or regulatory shifts may impact the service's reliability and accessibility. Stakeholders must remain vigilant and adapt strategies to navigate geopolitical complexities that could influence the smooth operation of the Sea-Air Service across the China-Europe trade route. Furthermore, while the environmental benefits of the Sea-Air Service are noteworthy, challenges related to achieving a truly sustainable supply chain persist. The service's reliance on air transport, even in a reduced capacity, still contributes to carbon emissions. Additionally, the environmental impact of the shipping industry, including issues such as fuel consumption and waste management, presents an ongoing challenge that necessitates continuous improvement and innovation.

6. Recommendations for DHL Global Forwarding in achieving future sustainable development

In light of the analysis conducted regarding DHL's Sea-Air Service from China to Europe, the ensuing recommendations are formulated for DHL Global Forwarding to facilitate the achievement of future sustainable development objectives, which mainly evolve around decarbonization acceleration, supply chain transparency, and stakeholders engagement.

Firstly, regarding decarbonization efforts, DHL Global Forwarding should prioritize the acceleration of electrification by emphasizing the transition to electric and hybrid heavy-duty trucks, complemented by substantial investments in charging infrastructure and the exploration of collaborations with fuel cell and hydrogen technologies. Additionally, the company should evaluate its sea-air freight operations to enhance efficiency, which includes exploring alternative routing options, investigating the adoption of more fuel-efficient aircraft technologies, and implementing measures to encourage customers to opt for less carbon-intensive alternatives. To reduce carbon emissions further, DHL Global Forwarding should actively promote modal shift

strategies, advocating for and incentivizing the use of ocean and rail freight alternatives, particularly for long-haul transport of lower-value goods, and forging strategic partnerships with shipping lines and rail operators committed to sustainable practices.

Secondly, DHL Global Forwarding should prioritize supply chain transparency by extending emissions monitoring efforts beyond its direct operations, which includes broadening the scope of emission measurement and reporting to encompass upstream and downstream partners within the supply chain network. Collaborative efforts with suppliers are also essential, with DHL Global Forwarding working closely with its suppliers to facilitate the adoption of sustainable practices and the reduction of their environmental footprint, providing support and incentives to encourage the implementation of environmentally friendly initiatives within DHL's supplier network. To enhance transparency and empower informed decision-making, the company should also improve data accessibility by sharing supply chain data and sustainability metrics with customers, enabling them to make choices based on the environmental impact of their decisions.

In terms of engagement and innovation, the company should establish stronger collaborative partnerships with its customers to jointly formulate sustainability goals and initiatives, tailoring bespoke GoGreen solutions that align with specific customer needs and environmental priorities to deepen these relationships. To remain at the forefront of sustainability efforts, it should expand its investment in research and development, which would foster a culture of innovation in clean technologies, alternative fuels, and logistics optimization, and expedite the invention of innovative solutions such as drone delivery and hyperloop technologies. Additionally, active engagement with policymakers and industry associations is crucial, with DHL Global Forwarding advocating for regulatory frameworks and incentives that promote sustainable practices across the logistics sector.

In addition to these recommendations, maintaining a commitment to comprehensive and transparent sustainability reporting is essential, which encompasses progress updates, identified challenges, and future-oriented strategic plans. While carbon offsets may serve as a temporary solution, it is imperative to prioritize long-term decarbonization strategies, utilizing carbon offsets responsibly and concentrating on implementing sustainable practices with enduring environmental benefits. Furthermore, integrating social sustainability initiatives into your strategy is essential, including ethical sourcing practices, labor standards, and community development.

The implementation of these recommendations will empower DHL Global Forwarding to solidify its leadership in the field of sustainable logistics, attract environmentally conscious customers and contribute substantially towards a greener future for the industry. It is essential to recognize that the pursuit of sustainable development is an ongoing endeavor, and these recommendations serve as a foundational framework for DHL's persistent commitment to this pursuit.

7. Conclusion

In conclusion, multimodal transportation, exemplified by DHL's Sea-Air Service from China to Europe, holds significant promise in mitigating environmental impact, enhancing economic competitiveness, and fostering flexibility in supply chain management.

Dimensional analysis of DHL's Sea-Air Service highlighted its potential to offer faster and more cost-effective alternatives compared to traditional shipping methods, concurrently reducing the carbon footprint associated with air transport. This strategic integration aligns with global sustainability efforts, contributing to reduced pollution around major airports, and offering economic advantages marked by cost predictability, flexibility, and global economic connectivity.

Beyond the immediate economic and environmental benefits, the Sea-Air Service may potentially catalyze a more extensive transformation within the industry towards sustainability as both consumers and businesses exhibit an escalating demand for supply chain practices rooted in environmental responsibility, in which DHL's strategies have situated itself as an industry leader.

Nevertheless, the study underscored that challenges and limitations persist, including the inherent complexity of coordinating multimodal transportation, inherent complexity of multimodal transportation, geographical and infrastructural dependencies, geopolitical uncertainties, the industry's ongoing sustainability challenges, and the service's reliance on air transport, which continues its contribution to carbon emissions.

These findings necessitate the company's continuous efforts towards sustainable development, highlighted by extensive decarbonization, supply chain transparency, and collaborative strategies to promote different stakeholders engaging in environmentally responsible practices.

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