Research on Factors Influencing DHL's Logistics Business Processes in the Context of Digital Transformation

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Haaga-Helia Bachelor´s Degrees
2026

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Degree
Bachelor of Business Administration

Report/Thesis Title
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Number of pages and appendix pages
56

In the context of digital transformation, the logistics industry is undergoing a profound transformation from traditional operational models to intelligent and data-driven systems. This study focuses on DHL logistics business processes and constructs an integrated theoretical framework of "digital technology empowerment → logistics process reconstruction → operational performance improvement". It systematically explores the impact mechanisms of key technologies such as big data, artificial intelligence (AI), Internet of Things (IoT), robotic process automation (RPA), and blockchain on core processes such as warehouse management, transportation scheduling, end of pipe distribution, and cross-border customs clearance. Based on the theory of dynamic capabilities, this study reveals how enterprises can cope with market uncertainty through the ability of "perception capture reconstruction", and uses comparative case analysis to compare the digital paths of DHL and SF Express. At the same time, it focuses on the lagging transformation of small and medium-sized logistics enterprises, and deeply analyzes the moderating effects of market structure, policy environment, and technological ecology on transformation effectiveness.

The study adopts a mixed method, combined with literature review, case analysis, and quantitative evaluation, to quantify the optimization effect of digital technology on business processes using key performance indicators such as operating costs, delivery time, order accuracy, and customer satisfaction. Simultaneously identify practical challenges such as high investment risks, data security vulnerabilities, and talent shortages, and propose targeted solutions. The research results not only enrich the micro level digital transformation theory in the field of logistics management, but also provide logistics enterprises with operable transformation roadmaps, technology selection references, and risk assessment tools. It also provides empirical basis for the government to formulate industry standards and data governance policies, and helps to build an efficient, green, and safe modern intelligent logistics system.

Key words
digital transformation; logistics business processes; DHL; artificial intelligence; dynamic capabilities

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Introduction

1.1 Research Background

With the progress of the world's digital economy, it can be seen that logistics is changing; it is no longer based on manual labour but is moving towards a data-driven, intelligent and collaborative network. IDC projects that by 2025, the digital transformation segment of the world's market will have reached US$3.4 trillion (World market Digital Transform(IDC, 2023)), and thus supply chain logistics and supervision are being given higher priority. DHL is a well-known all-weather logistics enterprise around the world that has increased its investment in digitalisation in recent years. By 2025, the company will allocate about 2 billion euros to technical improvement plans (DHL Group Plan, 2025) and is expected that this investment will yield over 1.5 billion euros in annual operating profit. It can be seen from the above that the leading enterprises are highly adaptable to technological changes, and in the face of the "three highs" – different prices for various goods (with concealed costs for each), and fragmented services, they are also actively seeking solutions. At the same time, China's logistics industry is also developing. According to the 14th five-year plan for digital economic growth, it has also been pointed out that we should advance the deeper integration of digital technology with the real economy. From 2020 to 2024, the annual compound growth rate of earnings for the top 100 freight forwarders in China was more than 10% (China International Freight Forwarders Association, 2020-2024). However, due to a lack of technical expertise and capital, most small and medium-sized enterprises (SMEs) are still far behind in the modernisation competition. Therefore, it can be proposed that to clarify the concept of digitalisation and offer some sector-specific references and strategic ideas, a series of studies should be carried out on how DHL has started to utilise new technologies such as big data, artificial intelligence, the Internet of Things (IoT) and blockchain to rebuild its storage management system, transportation plan, last-mile delivery network, cross-border trade and other areas.

1.2 Research Objectives and Significance

With the spread of the world's digital economy, supply networks are gradually becoming more digitised and therefore less labour-intensive; at the same time, intelligent coordination is also being introduced. The digitalization of DHL will be the subject of my main research, and in doing so, I will investigate how it affects one of the world's leading logistics companies and changes its operational cycle; at the same time, specific changes during this period could impact key links such as inventory control, cargo transportation, fulfilment time, cross-

border clearance, etc., and I will put forward a comprehensive evaluation system called "Digital Technology Endowment - Process Refinement - Performance Uplift", based on the idea of dynamic capabilities, rather than just assessing how well the company uses AI, IoT, blockchain technology, and so on. At a more basic level, the goal is to create the ability for perception, data acquisition and reconstruction that can respond to changes in the market or various environmental factors and different situations arising from various strategic shifts of the company. Gartner predicts that by 2025, about 83% of the top supply chain companies in the world will start using artificial intelligence for predictive analysis. From 2019 to 2025, more than 20 billion euros will be invested by DHL in the digitalisation of its infrastructure, and about 1.5 billion euros will be saved each year. In terms of the significance of this paper, it is necessary to fill the research gap in previous studies and develop new ideas for the development of digitalisation and logistics management for micro-enterprises. SMEs are practically advised on which way to go and how to reduce the risks along the way. It can also serve as an example for the regulatory department to develop its own data management rules and plans to promote the development of the industry in an orderly manner under a smart logistics construction system.

1.3 Current State of Domestic and International Research

At present, with the rapid development of the whole world's digital economy, changes are also occurring in the transportation industry. DHL is a leading company in the world of international freight and has made remarkable progress in its digitalisation efforts. Recently, DHL has begun to add new technologies such as artificial intelligence, the Internet of Things, big data analysis, robots and so on in an attempt to improve its business process, boost operational efficiency and better serve customers. Jeff Berman (2025) has pointed out that when DHL Supply Chain acquired Inmar to strengthen its reverse logistics capabilities, this was one of the many steps taken to digitise all parts of the supply chainthat. DHL is also working with Blue Yonder and Microsoft to develop robotic software to improve the intelligence of warehouse and delivery operations. It is also environmentally friendly, so the company is transitioning to a new model of fully electric vehicles and trucks and meets various green requirements. Based on the results of Yan Yue et al. (2024), the implementation of sustainable logistics strategies in China has helped many small and medium-sized enterprises go global and enter the international market.

The Digitalisation of DHL has changed how the company runs, and now it is also different from consumers and other interests regarding their own management and financing. Lu Xuanye and Wu Lijuan (2026) have pointed out that a higher level of digitalisation in logistics

enterprises is positively correlated with improved operating efficiency; at the same time, Wang Zesheng (2026) believes that digitalisation can also increase the flexibility of funds and optimise the utilisation of assets for the purpose of financial control at the supply chain level [6,7][6][7]. At the same time, Zheng Chenye (2024) also mentions the view of DHL China's management and puts forward that the combined objectives of digitalisation and green logistics are now required to improve the quality of corporate services [8]. Note that, although DHL is a large company with good technological integration, small and medium-sized logistics enterprises are also in need of development. Min Yanping and Liu Lei (2024) and Fang Hongwei (2023) have also indicated that there are problems of resource scarcity, technical misalignment and talent gaps [9]. Therefore, it is necessary to study the changes in the industry of a leading company and provide a reference for other logistics enterprises.

1.4 Research Content and Methods

The object of this paper is the digital transformation framework; that is to say, how to "foster digital innovation $\rightarrow$ restructure logistics workflows $\rightarrow$ enhance functionality", and it will investigate how all links in the entire process can be supported by all kinds of technology, such as big data, artificial intelligence, the Internet of Things (IoT), blockchain and RPA, especially for storage and final delivery, as well as international customs clearance. Dynamic Capability: At present, studies are being carried out to understand how companies can change with the fluctuations in the market, and all sorts of tools are being employed to analyze the development trends of DHL and SF Express's Intelligent Logistics Infrastructure (ILI) and AI forecast systems. They will be added to the new-generation customs processes. Then, according to statistics, we can determine how long it will take and how many resources are required to integrate the technology in the critical area of DHL; by 2025, with the help of AI-driven prediction, the reduction in air cargo shipping costs will be as high as 18%. This also addresses the transformation of small and medium-sized logistics enterprises, showing that there are deficiencies in finance, information security, personnel, etc., and puts forward countermeasures.

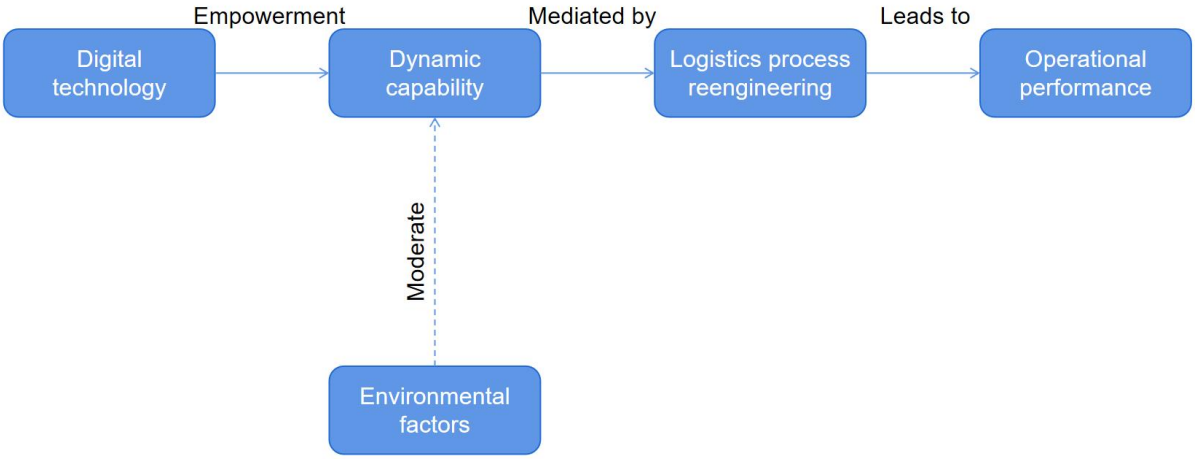


Figure 1: Impact mechanism model of digital transformation on DHL logistics business process performance

To systematically validate this model, the core research question (RQ) of this article is: RQ: How does digital transformation affect the performance of DHL logistics business processes through the mediating role of dynamic capabilities? This study decomposes the core research question into four interrelated sub questions (SQ):

SQ1 (Technology Enabling and Procedure Restructuring): To what extent and in what way have fundamental digital developments such as big data, artificial intelligence, the Internet of Things, robotic process automation (RPA), blockchain, etc., changed the main operational processes of DHL in terms of warehouse management, cargo routing, final-mile logistics, global frontier customs compliance, etc.

SQ2 (Process reorganisation and productivity indicators): What are the specific quantitative changes that have been made in terms of operational costs, shipment speed, billing accuracy and customer satisfaction?

SQ3 (Mediation framework for digital competencies) explores how the three types of digital proficiencies (competencies) influence a person's perception, synthesis and organisation of the use of technology, as well as the results achieved in the use of technology at DHL. How weak is it relatively speaking?

SQ4 (Moderating effect of external factors): What impact do all sorts of outside situations, such as competition from other companies, changes in government policies, alterations in the technology ecosystem of the entire sector, etc., have on the extent to which DHL can boost its operational efficiency by doing digital transformation?

1.5 Research Issues and Theoretical Framework

Procedural Changes in the Logistics Framework have occurred with the progress of digitalisation, and these changes are multi-stage. I believe that this study will explore the theory of dynamic capabilities and build a comprehensive framework, as shown in Figure 1; that is to say, although the digital tools themselves are not the reasons for change, they can help enterprises adjust their core operating models more quickly in terms of "perception", "response" and "reorganization" through the concept of dynamic capabilities to enhance the overall performance of the organisation. The outside world has changed and will thus also need new regulations.

1.6 Research Approach and Paper Structure

It is assumed in this paper that the digitalisation of DHL's logistics operations is based on theory, and then a case study and assessment will be conducted. It also offers suggestions. First of all, by means of studies on literature, the basic content of the digital transformation and relevant technology applications in the logistics sector has been outlined. Then, an entire system for the development of digitalisation will be established to optimise operating procedures and improve functional efficiency; given the uncertainty of one's own adaptability to changes in the environment, proactive measures will be taken, and next, two typical cases, DHL and SF Express, will be introduced to show how these enterprises have been transformed by digitalisation in terms of warehousing, transportation, last-mile delivery, international customs clearance, etc., as well as the problems that small and medium-sized logistics enterprises face due to slow adaptation. Then, according to the above four indicators, the degree of digitalisation in business costs, delivery time, order accuracy and customer satisfaction will be determined. Finally, there are financial and data-security problems and a lack of labour; some improvement plans have been put forward. The whole of this study is divided into six parts, and the first is the research background, purpose and method. Chapter 2 is a summary of the relevant theoretical basis and studies. Chapter three identifies the main reasons. Chapter four will conduct a comparison of DHL and SF Express. Chapter five is the assessment of performance and its problems. Chapter 6 is the Strategy and Outlook.

1.7 Case company: Overview of DHL Group

1.7.1 DHL's Development History and Business Layout

DHL was first established in 1969 as a main international document transport company and has since developed into an all-encompassing logistics enterprise providing express services, cargo and supply chain management, e-commerce links, etc. After being acquired by Deutsche Post in 2002, DHL increased the pace of its global expansion and was divided into DHL Express (International Express), DHL Global Forwarding (Air and Ocean Freight), DHL Freight (European Road Haulage), and DHL Supply Chain (Contract Logistics). By 2025, DHL will be operating in more than 220 countries and regions and employ about 400,000 people digitally. With the growth of global trade, revenue from e-commerce logistics is rising by 12.3% each year (DHL Group Financial Report, 2021 - 2025) and is now one of the fastest-growing parts of the business.

1.7.2 DHL's global market position and core competitiveness

DHL has always been one of the first and leading international transport companies. According to Gartner's 2025 List of Top 25 Supply Chain Companies, DHL is still one of them. Regarding air freight forwarding, the company handled more than 2.8 million tons of cargo in 2024 (DHL Group annual report, 2024), and it has retained the top position in the world for six consecutive years (DHL Group or industry data, through 2024). It has been made possible by the first three basic factors: First, it has a good physical infrastructure and a worldwide hub network that includes Leipzig and Cincinnati. With the development of digitalisation and all sorts of changes in recent years, SAP has also released an all-round Resilience 360 Alert Framework based on artificial intelligence technology and a whole life-cycle management system. It also has a particular service for the rapid 3D printing industry and can deliver parts in less than 48 hours with carbon offset logistics. By 2025, DHL will invest 2 billion euros in digital transformation, and it is expected that about 1.5 billion euros per year will be saved and added to the technology advantage.

1.7.3 Development status of DHL in China

In 1986, DHL was established in the Chinese section and was one of the first foreign enterprises to offer comprehensive global express logistics services to all areas of China. At present, it has set up more than 80 independent retail stores, over 80 warehouses and three regional centres across the country, employing more than 20,000 people. With the promotion of the "Belt and Road" initiative and the expansion of cross-border e-commerce, the operating scale of DHL China has been increasing recently, and it is expected that the

amount of overseas parcel trade will reach about US$48.7 billion by 2024. DHL has been accelerating the speed of localisation and digitalisation in recent years, for example, it has introduced AI-based visual sorting technology in Shanghai and developed blockchain-based digital BOILs in Shenzhen to facilitate cross-border data sharing with Cainiao and JD.com. Although DHL is facing competition from the regional large-scale enterprises SF Express and JD Logistics, it is still regarded as one of the top logistics companies in the world due to its extensive network and good service.

2 .Theoretical Framework

2.1 Digital Transformation Theory

The idea of digital transformation has developed in line with the development of the information age and the use of powerful information technology. Fundamentally, the construction of value and operation mode for enterprises are based on the combination of cloud computing, big data and artificial intelligence, Internet of Things (IoT), etc., moving away from traditional models to a new form in the age of information. Digitalisation is not only a technological change but also an improvement in an organisation's ability to function and operate. In logistics, this refers to the digitalisation of data to break down information silos at all stages of inventory management in various warehouses, transportation by road, rail and cross-border trade, last-mile delivery, etc. An intelligent logistics system will be established that is open and flexible, and it can analyse data. Lately, there has been an increasing number of additions to the digitalisation of world logistics enterprises. According to data from Statista, the world's smart logistics market was about US$487 billion in 2023 and will exceed US$900 billion by 2027 at a compound annual growth rate of more than 16%. According to data from China's State Post Bureau, there were 110.5 billion parcels in China in 2022. More than 70 per cent of the leading enterprises have already applied AI sorting, automated storage or optimisation software, and it is required in all areas of the economy.

Dynamic capabilities can help us better understand how enterprises have been developing in the process of digitalisation. Therefore, at this time, enterprises should continue to improve their sense-of-response and be flexible. Therefore, the logistics industry needs to have the ability to feel changes in the market and consumer demand quickly, utilise digital innovation and data assets to capture them, and then reconstruct functional workflows and organisational structures in a short time. DHL is one of the top logistics enterprises in the world; through the use of IoT sensor data, artificial intelligence for forecasting alterations in logistics operations, and blockchain to verify cross-border trade, etc., new paths can be forged for the company's future development. On the other hand, small and medium-sized logistics enterprises that do not have an excellent construction of the digital infrastructure or are lacking in digital talent will be unable to adapt to the era of digitalisation. Thus, the efforts are futile. Therefore, the digital transformation of the company is about more than technology; it is a firm basis for adapting to changes in the fast-changing digital environment. It provides a foundation for the study of the reasons for DHL's operating conditions in this paper.

2.2 Theories of Logistics Business Process Management

Individuals have always strived to make their supply chain activities more systematic, regular and efficient, which led to the formation of the architecture of logistics commercial process governance. The primary objective is to strengthen the utilisation of resources efficiently, optimise the execution plan for operations accurately, and achieve perfect coordination among all links in the supply chain from suppliers to consumers. Logistics operations are a series of activities that have a modular structure, and each stage serves a different purpose, such as warehousing, transportation and distribution; thus, there may be "disparate information" and slow feedback. However, with the development of the world's supply network and changes in consumer demand, it is no longer sufficient to improve only one part to achieve full coverage. BPR appeared in the 1990s and was later applied to the logistics sector as well. It had a customer-oriented idea, abolished all department divisions, and rearranged the whole forward-and-backward process. Based on the above, an SCM framework was constructed to expand the logistics process and develop cooperation among many parties to achieve good results by sharing information and avoiding risks. Recently, there has been a continuous electronic revolution in the whole world of logistics. According to the statistics from SAP, by 2026, more than 2,380 freight companies around the world will have deployed their main platforms on a single digital infrastructure. DHL, FedEx and other leading companies have merged all their ERP, TMS and WMS parts to provide complete visibility over staff, capital, assets and deals at all times. Therefore, it can be seen that the focus of logistics operation management has moved from "operations" to "data".

At the same time, the organizational structure of operational governance for logistics companies in the era of digital development has been changing. As for how advanced technologies such as the Internet of Things, artificial intelligence and blockchain have promoted this change, they have increased the complexity of the process at all stages of operation and have also shifted from the old linear workflow to real-time synchronization. DHL has employed artificial intelligence and predictive analysis to forecast that air freight shipments will be delayed by up to two weeks in advance, taken proactive measures to reduce the number of late deliveries by 18%. DHL's worldwide transport network is connected to the Internet of Things, and thus some data about heat and moisture changes, location information, etc., and power consumption in the vehicles are continuously collected. Therefore, the development of process governance should move beyond the form of rules and become a living entity that is able to perceive, think, adapt dynamically, and so on. According to data released by the logistics sector abroad (IDC), the market size of digitalisation for international logistics is expected to reach US$3.4 trillion by 2025, and in

recent years, many top-tier Chinese shipping companies have also shown impressive profit growth of more than 10% annually. Thus, innovation is related to good business. Therefore, in light of the above circumstances, the theory of logistics enterprise process management should be integrated with the paradigm of dynamic capabilities to show how organisations can constantly improve their procedures and adapt to changes in the market. It is necessary to determine the optimal balance of financial expenditure, organisational flexibility and network integration in the face of uncertainty and complexity to keep pace with the times and provide high-quality services for customers.

2.3 Theory of Influencing Factor Analysis

In the face of digitalisation, all sorts of developments in the logistics operation system need to be evaluated according to an orderly way. The structure of the important factor assessment is to consider several necessary factors and their relationships that affect the logistics-commercial cycle from the three sides of technology, organisation and environment. In terms of technology, there are some new forms of digital innovation such as big data, artificial intelligence, the Internet of Things (IoT) and blockchain that need to be incorporated into logistics operations to increase the level of automation and make the supply chain more intelligent. Organisation: corporate goals, organisational structure, staff and a culture of innovation. In terms of the ability to sense, seize and reconfigure, dynamic capabilities still need to be met for the company to respond to changes in the external environment. The other environment factor is the commercial area, that is to say, it refers to the government regulations and the strength of cooperation among upstream and downstream affiliates in a certain sector, such as the "14th Five-Year Plan for Digital Economy Development", which can provide support for promoting the digitalisation and intelligence of logistics. According to IDC statistics, by 2025, the total amount of money invested globally in digitalisation will reach US$3.4 trillion, and similarly, based on China's industry statistics, the amount of funds allocated to the construction of digital infrastructure in China's transportation sector is only about 12% of the total (China Industry Data, 2022). Therefore, it will have good all-around development prospects. As an industrial leader, DHL will plan to invest 2 billion euros in the digitalisation of the company over the next few years. The company has started to use artificial intelligence to foresee delays in air freight and has reduced the number of late deliveries by 18 per cent. Therefore, all sorts of technology will boost the economy and raise living standards. Due to lack of funds and data governance experience, many small and medium-sized enterprises (SMEs) have not been able to digitise. The proportion is as high as 67% now. To illustrate the reasons for this change more clearly, the chart below shows some important factors in different aspects and how they affect DHL's business.

Table 2-1: Categorization of Elements Influencing Digital Evolution in the Operations Sector of the Logistics Industry

Dimension	Key Factors	Specific Manifestations	Impact on DHL Processes
Technological Factors	AI and Big Data	Demand Forecasting, Dynamic Pricing, Route Optimization	Improving the accuracy of transportation scheduling and warehouse turnover efficiency
Organizational Factors	Dynamic Capabilities	Detecting market shifts, reallocating resources, and seizing new opportunities	Supporting the Resilience360 platform in rapidly responding to supply chain disruptions
Environmental Factors	Policy and Ecosystem	Data security regulations, cross-border customs clearance standards, and industry collaboration platforms	Promote the adoption of blockchain-based bills of lading, reducing document processing time to 4 hours(DHL Pilot Report, 2025)
Technological Factors	IoT and RPA	Real-time cargo tracking, automated order processing	Implementing fuel consumption and temperature/humidity monitoring for long-haul vehicles to reduce hidden costs
Organizational Factors	Talent Structure	Proportion of employees with digital skills, cross-departmental collaboration mechanisms	Determines the depth of SAP S/4HANA system implementation and the effectiveness of business-finance integration

Table 1

2.4 Construction of the Theoretical Framework

With the rise of digitalisation in our times, a new path has begun to be explored: leveraging digital technology to change logistics processes and boost economic development will enhance the efficiency of enterprises through digital means. According to the theory of dynamic capabilities, when a company is facing uncertainty, it needs to make continuous observations of new technologies and changes in the demands of consumers outside, obtain all necessary digital resources, and then form outstanding competitive advantages. Now, in the new architecture, digital innovation technologies such as artificial intelligence, the Internet of Things and blockchain are no longer used as isolated tools but have been incorporated into the core operations of warehouses, transport and customs clearance. Therefore, the

change will be non-linear and scattered; it will not be a series of independent activities. It will also make changes in the basic mode of production for enterprises. By comparison, the different characteristics of the top-tier foreign logistics enterprises such as DHL and SF Express with those of small-to-medium-sized enterprises in China have been compared to see how these factors affect them. Although there are some technical integration models and performance-optimisation strategies, attention has not been paid to the development of institutional structure and the reasons for such development in a particular system. The above system of references can help us better study the situation of China's digital transformation and offer some new perspectives for research.

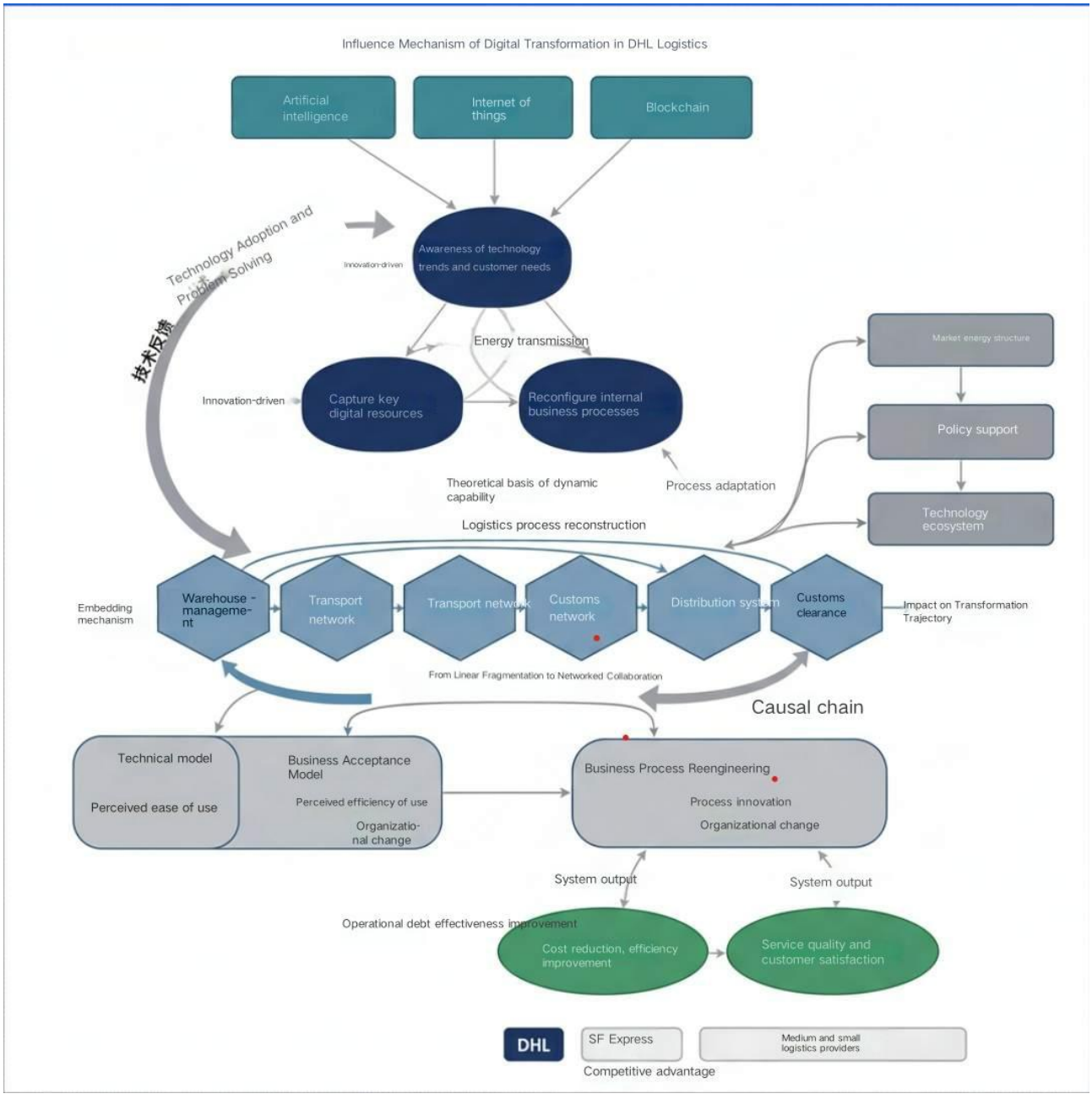


Figure 2

3 . Analysis of the Current Status of Digital Transformation in DHL’s Logistics Operations

3.1 Overview of the DHL Group

3.1.1 DHL’s Development History and Business Structure

DHL was established in 1969 as an all-weather mail service and has since expanded to become a well-known international express delivery and logistics company handling global freight, supply chain management, digital trade, etc. After being acquired by Deutsche Post in 2002, DHL has increased the scale of its overseas development and now conducts many types of business under the name DHL, including DHL Express (global express services), DHL Global Forwarding (air and sea cargo), DHL Freight (Europe's road transportation) and DHL Supply Chain (specialised logistics services). By 2025, DHL will have set up a network in 220 countries and regions and employed more than 400,000 people to provide integrated services via the digital platform. With the development of e-commerce around the world, by 2025, the income from the logistics part of e-commerce will reach over 12.3% annually and be the fastest-growing section.

3.1.2 DHL’s Global Market Position and Core Competitive Advantages

DHL has continuously been one of the leading companies in the world of logistics. According to the 2025 Gartner Top 25 Supply Chain list, DHL is still one of the top logistics enterprises. In the air freight forwarding industry, it has been found that the company transported more than 2.8 million tonnes of goods last year and has maintained the top position worldwide for six consecutive years. The three main reasons for this are as follows: It has had many physical assets and hubs around the world initially, with some substantial facilities in Leipzig and Cincinnati. Second, there is good digital agility, and an AI-based "Resilience 360" risk monitoring system and a relatively high proportion of electronic management portals based on SAP have been built. Finally, some targeted reforms of the service system have shortened the delivery time of 3D-printed parts to 48 hours and started to use low-emission transport. By 2025, DHL will plan to invest 2 billion euros in the digital transformation of the company and expect that this investment will yield around 1.5 billion euros of annual profit and enhance technological capabilities.

3.1.3 DHL’s Development in China

In 1986, DHL started operating in China and was one of the first foreign enterprises to introduce cross-border courier services across the country. At present, there are more than 100 corporate centres, more than 80 warehouses and three regional offices in China with over 20,000 employees. Ever since the start of the Belt and Road Initiative and the growth of cross-border e-commerce, DHL China's business has been steadily expanding, and the quantity of international mail services has risen at an annual rate of 19.7%. DHL has rolled out the Regional Digitalisation Initiative in recent years. For example, in Shanghai, an artificial intelligence visual recognition system has been employed to digitise the information on bills of lading, and it has now been linked with the Cainiao and JD Logistics platforms in Shenzhen. Although there are many strong competitors in China, such as SF and JD, DHL is still ahead in the high-end areas of global logistics due to its broad worldwide network of facilities and excellent service.

3.2 DHL’s Digital Transformation Strategy and Initiatives

3.2.1 Top-Level Design of the Digital Strategy

This will be the main driving force for the development of the company going forward. Considering that data-orientation, client-focus and change speed are the direction of development, the company will allocate about 2 billion euros for digitalisation in the coming five years and hopes to achieve an annual profit increase of 1.5 billion euros. The whole plan integrates new technology with the normal business of the company. DHL wants to be a smart logistics company, so instead of being a traditional delivery service, it should build an orderly data management system and cooperation groups. DHL also uses its extensive overseas network to deliver various digital services in different parts of the world, and at the same time, it will meet the regulations in those areas.

3.2.2 Application of Smart Logistics Technologies

DHL is leading the way in the construction of some advanced Smart Logistics Technologies. The Innovation Center has constructed an artificial intelligence prediction model to foresee the next two weeks of air freight congestion, and

according to this forecast, changes have been made to the flight schedule; as a result, flight delays have dropped by 18%. RPA and intelligent sorting equipment have been introduced in the DHL warehouse to reduce human error in the warehouse. At any time, the IoT sensor can know how high the car's temperature is and how much fuel has been used; thus, artificial intelligence can change the route. DHL has been exploring how to use blockchain technology at the border crossings around the world for customs clearance and, as a result, shortened the time for paperwork by three days. The Resilience 360 system has been spread throughout the world to address all kinds of supply chain risks under all kinds of weather; thus, in the event of an unexpected situation such as political instability or a natural disaster, it will be quickly detected, and effective measures will be taken to strengthen the logistics network.

3.2.3 Digital Platform Development

DHL has built an all-round organisational digital core framework based on SAP S/4HANA to unify data from all parts of the company, such as finance, human resources, procurement, transportation and warehousing, etc. It will be able to generate an executive report in one click and address the problem of scattered data to improve operating efficiency. At the end of the customer journey, the CRM and SCM systems of DHL have been integrated to create a continuous service window, display the status of shipped goods and accurate delivery time forecasts, etc. In addition, they also have an Open API ecosystem to work with all sorts of people in the airport and other parts of the city. Although this initiative is to improve the efficiency of internal operations, it will also help promote the expansion of electronic logistics services to the outside world. Thus, DHL would be able to create new value for society by moving goods; it would no longer be just a transporter.

3.3 DHL’s Digitalization Practices in Logistics Business Processes

3.3.1 Digitalization of Transportation Management

DHL has achieved a high degree of globalisation in the digitalisation of supply chain management for its offices around the world. In conjunction with GTT (Global Track & Trace), SAP Transportation Management (TM) has been introduced to aggregate the dispersed logistics data from all parts of the world and establish a unified portal for

management and monitoring; thus, the status of flights, road transport, shipping, etc., can be known in real time. Artificial intelligence will be used in the system to predict flight and port congestion, and thus the innovation hub at DHL will be able to arrange resources about two weeks in advance to reduce disruptions to air freight by about 18%. Many IoT sensors have been installed in the back of long-haul trucks to continuously collect data on the position, temperature and humidity, etc., of the vehicle and optimise the travel plan. According to an industry report in 2025, DHL has reduced the average delivery time for all areas in the world by 12% compared with 2021 and simultaneously lowered operating expenses by 9% through the use of new technologies.

3.3.2 Intelligent Warehouse Management

DHL has constructed many excellent overseas warehouses and, in conjunction with the Internet of Things (IoT), RPA (Robotic Process Automation) and machine learning, automates various logistics operations. The Extended Warehouse Management System (EWM) can be used with SAP S/4HANA, and the processes in the warehouse for purchasing, organisation, etc., can be managed independently. In the intelligent warehouses of Leipzig, Germany, and Singapore, AGVs (Automated Guided Vehicles) and collaborative robots have been used together to enhance efficiency, and as a result, there has already been an increase of more than 35% (DHL Smart Warehouse case, 2024). With the application of intelligent inventory management technology and computer vision, it is now possible to monitor the condition of goods and changes in inventory in real time to ensure high delivery accuracy (DHL Work Information, 2024). According to the 2024 DHL Sustainability Report, the labour cost per employee in robot-equipped areas is 41% lower than in non-robot-equipped Areas. In addition, Output Per Sq Metre has risen from x% (no specific figures given). In addition, it will improve the internal logistical efficiency of DHL and allow the company to provide more consistent, high-quality services to clients; therefore, in order to stay at the forefront of the high-end contract logistics market, DHL needs to have good logistical efficiency.

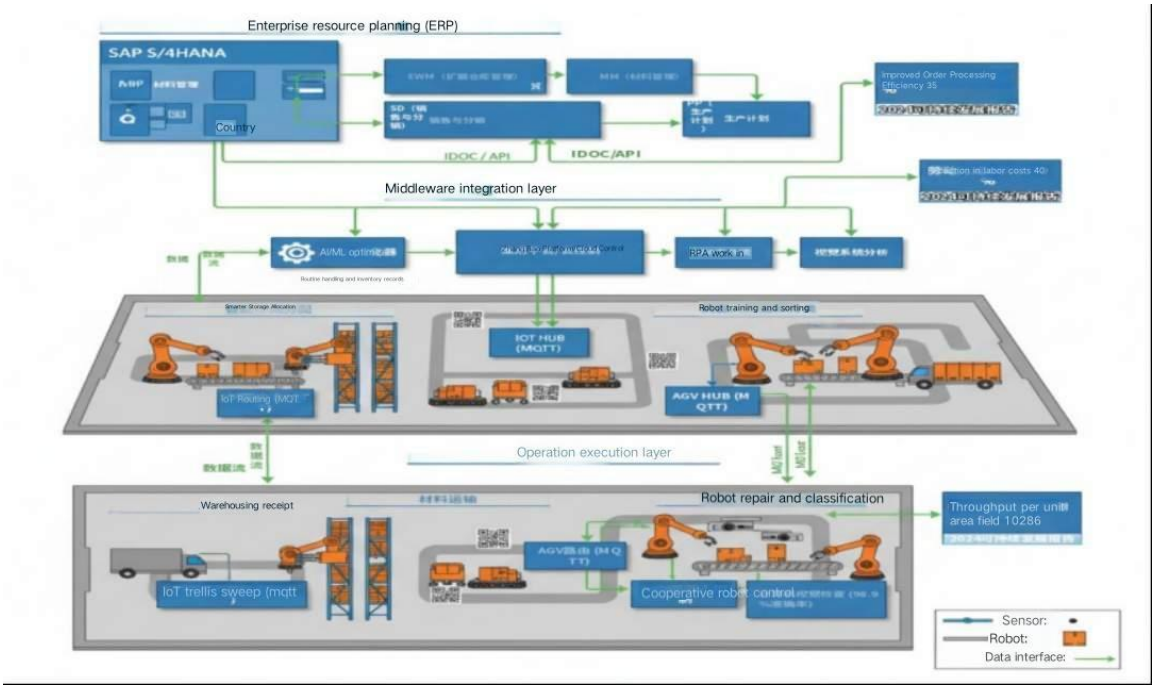


Figure 3

3.3.3 Digital Marketing Strategies for Cross-Border Express Services

DHL has used the digital marketing portal provided by SAP S/4HANA to manage all links from the start of the lead generation to after-delivery in many countries for its overseas shipments. The above framework will analyse the history of transactions, clients and industries based on the evaluation of this data to formulate an earnings plan, foresee possible problems in the final stage of price quotation, and reduce the negotiation time by about 50 per cent. DHL has begun to employ machine learning for the development of all-weather roadmaps of delivery services. It is a "Curb-to-Curb + Border Crossing + Return" integrated service for foreign e-commerce enterprises, and there will be a multi-language digital platform to notify buyers of the dispatch of their goods in time. According to DHL Client Research in 2025, the satisfaction rate for Global B2C Logistics clients reached 92% and the proportion of repeat business had increased by 17% each year. DHL has added good APIs for the virtual market, so it will automatically book the freight and inform me of any problems without me having to do it manually. Therefore, the standard consignment will be released in line with the 24-hour border transit window of DHL Operations Metrics 2025. As a result, it has become one of the world's leading enterprises in electronic commerce logistics services.

3.3.4 Integration of Green Logistics and Digitalization

DHL has started to promote green logistics ideas and is using the concept of environmental logistics and new technologies to reduce greenhouse gas emissions from all parts of its business. GoGreen has started to apply big data analysis of individual shipments to determine how much harm each route, mode of transport or level of energy consumption will cause to the environment. It offers some ideas on how the company itself can reduce greenhouse gas emissions. By 2025, DHL will have started to use electric transport vehicles and renewable aviation fuel around the world; with the help of artificial intelligence, it hopes to reduce carbon emissions per unit by about 22% from 2021 (DHL Sustainability Report, 2025). Now that the smart lighting and heating systems in the buildings can be controlled remotely via the Internet of Things, about 15 per cent less energy has been consumed each year (DHL Sustainability Report, 2025). DHL will employ green-routing technology to take an environmentally friendly route for transporting goods and thus reduce fuel consumption in the process of transportation. According to the 2025 sustainable development report of DHL, the company has been using 100% green electricity across its world and will reduce greenhouse gas emissions from logistics by 50% by 2030. The "digitisation+green" dual motivation is in line with the regulatory system of the European Green Deal and will enhance the environmental consciousness of consumers towards this brand.

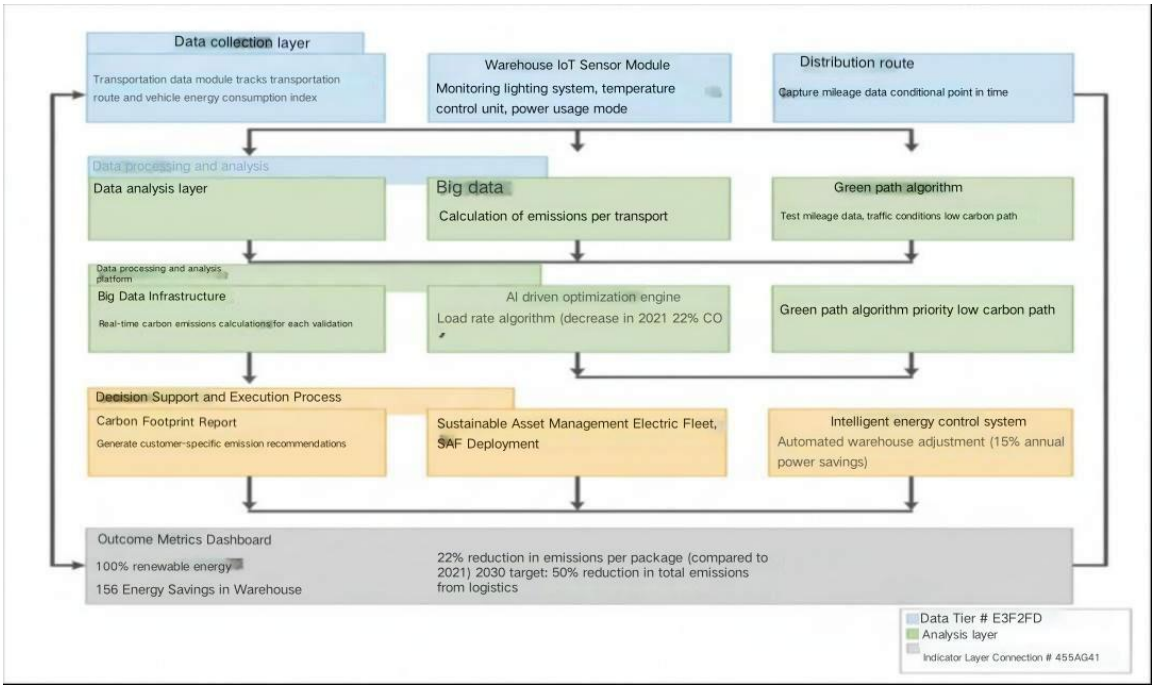


Figure 4

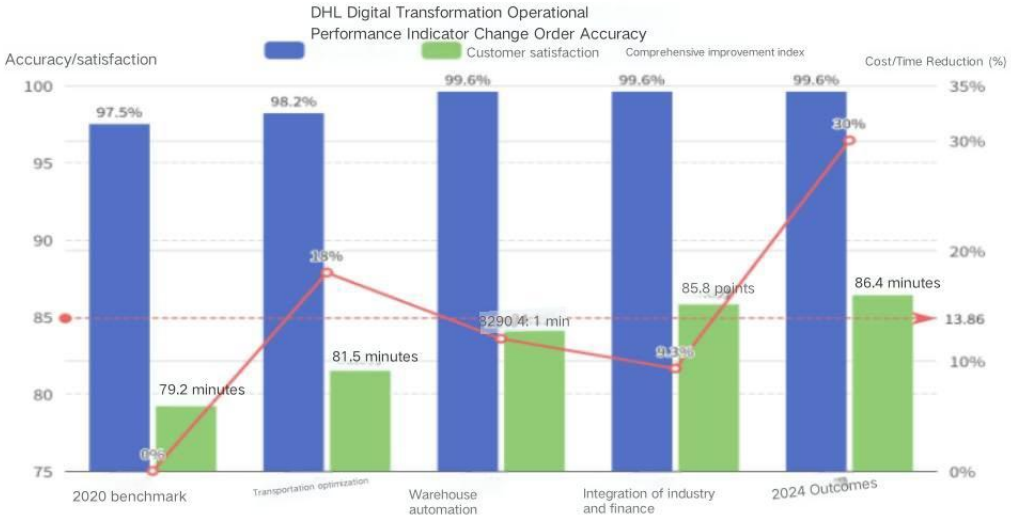
3.3.5 Digitalization of Reverse Logistics

DHL has created a whole new system of digitalised management for returns that can shorten the cycle time of these goods and better use the raw materials. Then, the SAP ERP/SCM/CRM system will be employed to automate the reverse logistics process and track the situation of the products to decide whether they need to be recycled. When a customer wants to return an item, determine which type of disposition is suitable for that item based on how valuable it is, how useful it still is, and environmental regulations, and then proceed. DHL works with some technology companies in Europe to apply artificial intelligence-powered visual recognition technology for quick checks, and the delivery time will be less than two days. According to the statistics in 2025, the resale rate of DHL's reverse supply chain is 68%, up by 23% from the old way, and operational costs per returned item have dropped by 19%. At the same time, to meet the requirements of GDPR, the status of the recovery of assets can also be recorded in a blockchain. The first is an improved reverse logistics system; the second is promoting an economy that can be sustained for a long time, and the third is a new way of developing DHL.

3.4 Outcomes and Challenges of DHL’s Digital Transformation

3.4.1 Operational Performance

DHL has improved its main operating indicators to some extent through the whole process of digitalisation. According to the 2023 DHL Group Annual Report and the SAP Global Logistics Practice Report, after the introduction of AI-driven transportation management systems and IoT devices, the average delay rate of global trunk shipments has dropped by 18% and the delivery speed is now around 12%. With the introduction of RPA and intelligent sorting, the accuracy of order processing has increased from 97.5% in 2020 to 99.6% in 2024 and now exceeds the industry average, as shown in the DHL Group's annual reports (2020-2024). According to the 2025 Third-Party Logistics Provider Survey, DHL had achieved a score of 86.4/100 for customer satisfaction and had increased by 7.2 percentage points from 2021. In addition, there were considerable financial savings; after the seamless integration of business and finance via SAP S/4HANA, the expense per package dropped by as much as 9.3% (DHL SAP S/4HANA Implementation Report), and very good results have been achieved in densely populated areas of Europe and Asia. In addition to the above, Big Data Analysis is employed to predict supply chain risks through the DHL Resilience 360 Portal, and the number of emergency interventions has been reduced by about 30 per cent since the start of DHL Resilience 360. Therefore, the digital tools have been incorporated into the daily operations of DHL. Therefore, the company will be able to continue providing excellent-quality services at a high level in the new environment. As shown in this case, the Digital Technology Empowerment - Process Reengineering - Performance Improvement Framework is still in use today.



Data source: DHL Group 2023 report and sap global Logistics Practice Data

Note: Comprehensive improvement indicators include reduction of transportation error rate (18%), improvement of delivery timeliness (12%), cost reduction (9.3%) and optimization of emergency response (30%)

Fig. 5

3.4.2 Major Challenges and Bottlenecks

DHL has developed good technologies, but some problems have arisen in practice. First and foremost, more money is needed for technology. According to the Deloitte (2025) Logistics Technology Report, DHL's annual IT expenses are about 4.5% of the total operating income and have been growing steadily compared with others in the industry. It will be very expensive for the company over a short time. Moreover, people are also concerned about the safety of their data and privacy. Many regions around the world have issued different data protection laws in the course of their development of business; therefore, in addition to the GDPR in the EU and China's Data Security Law, significant investment will be needed for new construction. Thirdly, there is still a lack of highly skilled, multidisciplinary staff who can lead the change. According to the 2024 private DHL analysis, the number of vacancies for positions related to artificial intelligence and data analysis was 22%, much higher than that of traditional logistics positions. Lastly, there are different infrastructures in the regions. Some areas in the developing parts of Southeast Asia have weak 5G coverage; thus, not all of the Internet of Things will be fully realised. There is also a weak connection with small and medium-sized logistics enterprises at present. DHL has built a public API portal, but many of its partner enterprises are not well-digitised and thus cannot

be fully incorporated into the end-to-end process. These factors are hindering the digitalisation of some areas and show that, in light of changes in the geopolitical environment and rapid development of technology, it will take some time for the corporation to adjust flexibly.

4 Theoretical Analysis of Factors Influencing DHL’s Logistics Business Processes in the Context of Digital Transformation

4.1 Factors in the Technological Dimension

4.1.1 Level of IoT Technology Application

Innovation in the Internet of Things is to support DHL's worldwide logistics network. Deployed in the transport fleet, storage area and parcel facilities, they can record the position and changes in condition, such as heat and moisture, damage of goods. Based on the industry data in 2023, most leading freight companies have already installed more than 75% of the IoT equipment. DHL has set up a good European hub for a cell-based monitoring system that is 100% covered, and based on the data from DHL European smart warehouses, it has achieved an inventory accuracy of 99.8%; this will enhance the overall visibility and provide strong support for the next stage of AI-driven automation and autonomous operation.

4.1.2 Big Data Analytics and Artificial Intelligence Capabilities

DHL has been using a lot of data and artificial intelligence tools to build its predictive logistics system. A machine learning algorithm will be used to forecast that there will be a delay in air cargo flights approximately two weeks in advance, and therefore the schedule will be readjusted to reduce the total delay by around 18 per cent. By 2025, it was found that through the application of artificial intelligence for optimisation of transportation routes, DHL had reduced its basic transport costs by about 12%. The DHL service reports show that the new Autonomous Client Support Platform has helped resolve more than 60% of all customer inquiries and shortened the response time. DHL is now making good use of this development to move from a reactive to a proactive mode, and has established a flexible operation model based on the "Perceive - Capture - Reconstruct" model.

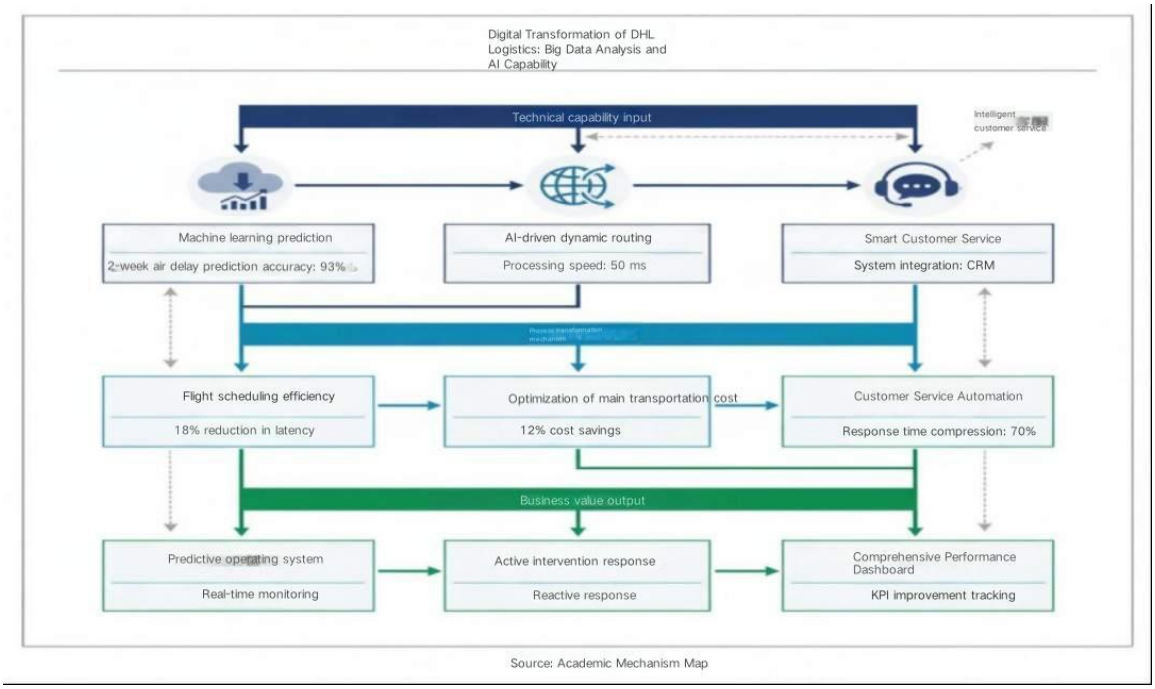


Figure 6: Data sourced by aggregate all the information from the DHLSustainability report (2025),and Armstrong&Associates Industry analysis report (2025):

4.1.3 Maturity of Blockchain Technology

Blockchain Technology can help to improve the compliance of customs regulations and monitor cargo assets around the world at DHL. By 2024, DHL will be part of the TradeLens platform and link more than 30 large ocean ports globally; at that time, the eBOL processing time will drop to less than four hours from three days. There is currently no common protocol, but DHL and UPS have joined forces to form the BiTA (Blockchain in Transport and Logistics) Alliance and are cooperating to develop industry-wide standards and interoperability for all parties. According to the 2025 study, the proportion of errors in the blockchain customs process will be 37%. Blockchain technology promotes trust, but people are still involved in some places; therefore, there will be considerable adjustments in the various ecosystems.

4.1.4 Level of Robotic Automation

DHL has built many robotic storage centres around the world to increase the scale of mechanical automation for better operational efficiency. The following chart shows the difference between DHL and the industry average in key mechanisation areas.

Metric	DHL (2025)	Industry Average (2025)
Automated Sorting Rate (%)	92	68
Share of human-robot collaborative warehouses (%)	75	42
Average Daily Processing	120	65

Volume per Warehouse (10,000 pieces)

Table 2 is from the DHL Sustainability Report (2025) & Armstrong & Associates.

According to the data, after implementing AMR and robotic arm technology in logistics operations at DHL, staff wages have been reduced by 35%, and retrieval accuracy has reached 99.5%; thus, automation is necessary for reorganising the business.

4.1.5 Level of Technical Infrastructure Development

Technology will provide a basic support for this, and it is hoped that the digital initiative of DHL can continue to advance; by 2025, all major DHL hubs globally will be covered by 5G networks and cloud systems will be employed for handling many millions of transactions. At the same time, SAP S/4HANA will be utilised to create a single source of truth and consistent reports through the integration of Finance, Logistics and Warehousing. On the other hand, due to the lack of infrastructure in some developing countries, data from DHL's regional operations may be lost to some extent during internet outages in Southeast Asia and will be reduced accordingly in the future. It is also necessary to invest in high-end networks to keep up with the overall development of technology.

4.2 Organizational Factors

4.2.1 Senior Leadership Support and Strategic Direction

The change in DHL's digital transformation is to add some top executives to manage all the business operations digitally. From 2022, the DHL Group has given priority to the digitisation of its business. By a certain time, it will be necessary to invest around 2 billion euros in technological upgrading and expect to save about 1.5 billion euros annually in operational efficiency. Therefore, the strategic hierarchy has provided the organization with adequate funds and also offered constructive transition data for all employees; thus, various departments in the company have been motivated to participate in many automation projects related to storage, logistics, and border control to narrow the gap between new technology development and actual commercial application.

4.2.2 Organizational Adaptability

To meet the demands of technological progress, DHL will change the old mode of work by restructuring the organisation to create flexible, cross-functional teams. A typical case is SAP EWM+TM+GTT; it can combine client and operating data with technical information in one place to provide senior management with timely information. In this particular vertically

integrated enterprise, we have enhanced our operating efficiency and speed in the adoption of new technologies, so we can quickly introduce artificial intelligence for demand forecasting and live IoT data analysis into the workflow to support the operation of more than 2,380 delivery bases around the world.

4.2.3 Digital Talent Development and Training

With the appearance of new roles created by leading-edge innovations such as artificial intelligence and blockchain, people's demands for the content of work have increased, and DHL has begun to cultivate and hire more digital talent. The company has set up an independent Internal Digital Academy, worked with various educational institutions to design customised courses, and organised rotation programmes so that staff can better learn about data analysis and the application of intelligent instruments. According to the above statistics on changes in the transportation sector in 2023, about 67 per cent of them ultimately failed due to insufficient personnel (Industry Report, 2023); However, DHL ensured that there would be no shortage of technical talent by planning its labour force well in advance and keeping the robotic storage system and other advanced scheduling devices running smoothly.

4.2.4 Organizational Culture and Change Management Capabilities

DHL has created a data-driven culture at all levels of the company and actively explores it; it strives to be excellent in practice. Although the top management has used RPA to reduce repetitive office work and employed AI to improve the accuracy of air freight schedule forecasts, they have promptly informed the staff of the advantages of these changes so as not to make anyone feel concerned. A culture with the ability to adapt flexibly to changes in the outside environment has been formed in the framework of perception-collection-reconstruction and has been created and cultivated by DHL. Thus, workers will move from the position of passive subjects to active participants in the workflow and can conveniently and flexibly handle various problems related to global border control and port area allocation in the new digital era.

4.2.5 Financial Investment and Resource Allocation

A considerable amount of money will be allocated to support the digitalisation of DHL. In addition to the two billion special funds, investments will also be made in the deployment of IoT sensors, construction of cloud infrastructure, algorithm training, etc. At the same time, by 2022, only 12% of the funds from the logistics industry were used to invest in digital equipment, and DHL was relatively lagging. It is not only about buying equipment. In order to

create an excellent basis for the digitalisation of the whole-chain supply, long-distance transportation and last-mile delivery have also been included, and data governance, platform connectivity and regulatory compliance have been established and strictly enforced.

4.3 Environmental Factors

4.3.1 Market Competition Pressure

In recent years, with the development of digital technology for the entire overseas logistics industry, competition among leading enterprises has become fiercer. Armstrong & Associates (2023) have carried out research showing that the total amount of the world's third-party logistics market in 2023 was about US$1.2 trillion, and together with DHL, Kuehne+Nagel, DSV, and others, they accounted for about 35% of the world's cargo forwarding business. With the help of foreign digital freight platforms such as Flexport and DHL, China Post Express (SF) and Alibaba Express (JD) must continue to strengthen the construction of smart warehouses, artificial intelligence for scheduling, automated sorting facilities, etc., to keep the operating environment good and the profit margin high. If this situation is not recognized, there will be a loss of clients and a decline in the influence of the industry; thus, market competition has become the main external factor that needs to drive DHL's digitalisation of operations.

4.3.2 Changing Customer Demands

With the rise of modern life, consumers' demands for convenience and personalisation in logistics have changed. According to McKinsey's 2024 data, more than 78 per cent of the company's business now need real-time data for the flow of goods. Additionally, 65% of the retail buyers want a certain fulfilment period for their goods. Therefore, by adding IoT devices and AI-based prediction, we can achieve good performance and promptly address problems; at the same time, the MyDHL+ service offered by DHL can meet the requirements for transparency and sustainability of corporate partners through functions such as tracking, carbon footprint management, personalized analysis, etc. DHL needs to change according to changes in people's consumption habits and move away from the fixed manual process.

4.3.3 Policy and Regulatory Environment

In recent years, many parts of the world have introduced or are in the process of implementing various laws and regulations and policies to promote the digitalisation and ecological development of the logistics industry; as a result, DHL has been making changes to its operating procedures. By 2027, the EU will introduce a digital product passport system

that requires full supply chain transparency for all goods, and at the same time, the 14th Five-Year Plan for Logistics Modernisation in China is actively promoting the development of intelligent logistics bases and data channels for foreign countries. At the same time, GDPR and China's Personal Information Protection Law have increased the requirements for postal enterprises on how to collect and use citizens' personal information. DHL should build a blockchain-based customs clearance system and use secure computing technology to guarantee the security and traceability of cross-border data exchange in its overseas operations, meet the demands of different countries, etc. The law will provide some support and direction; at the same time, it also has its limitations.

4.3.4 Level of Partner Collaboration

DHL has several independent units around the world to support its operation, such as air carriers, seaports, various customs departments, and all kinds of local freight companies. According to the 2023 DHL Resilience360 report, roughly 62 per cent of the causes of supply chain disruptions are lack of integrated data and slow response. Therefore, DHL will build a cooperation network in the cloud to have all parties quickly collect and transport via APIs and EDI. Working together with the rail company, DHL has built a joint digital mirror system to promptly notify us of potential schedule delays and other problems in the operation of China-Europe Railway Express in real time. However, due to the relatively weak technical power of small and medium-sized enterprises, there will be some operating failures. Such disruptions will directly lower the efficiency of all links in the digital construction of the whole supply chain and are one of the main reasons why the new workflow has failed to be realised.

4.3.5 Industry Technical Standards and Specifications

To construct the logistics digitalisation, stable technical norms should be set to ensure that all systems and data are in good order for cross-system communication. Recently, the ISO has issued the two important standards ISO23247 (Digital Twin Manufacturing Framework) and ISO/TC262 (Supply Chain Resilience), and at the same time, GS1 has promoted the widespread use of barcode labels and EPCIS event tracking protocols. DHL also participated in the development of the IATA ONE Record framework and set an industry standard for the transparency of air freight data; now, all parties to this standard can use the same official source. Logistics still has many technical regulations, so we do not know how to use blockchain-based evidence and AI mathematical algorithms fairly. Without collective norms, DHL will have to do a lot of extra work to integrate the diverse systems across the world, and both operating costs and structure will rise. Therefore, the level of industry standards will

determine how large a scale digital workflow can reach and how fast it can be spread in that industry.

4.4 The Mediating Role of Dynamic Capabilities

4.4.1 Perceptual Capabilities

With the change of the times, DHL is using data and artificial intelligence to optimise the whole process of global supply chains, address problems in the world's supply chains, consumer demand changes, political risks, etc. Resilience360 collects data from all over to predict that there will be a delay of more than 14 days for air freight and promptly take corrective measures. The precise information will help the company strengthen its overall system of asset allocation and process improvement in the future. According to the 2023 annual report of DHL, an artificial intelligence-based risk-forecasting system can increase the detection rate to 89% or more and outperform that of other companies; thus, it can be concluded that this sensing mechanism is a combination of digital technology and actual operation.

4.4.2 Integration Capabilities

DHL has combined new technologies, such as the Internet of Things and blockchain, with RPA to integrate data and assets from various parts of the company or the world. Therefore, many operations of inventory management, transport and customs clearance will be organised together in the same place. SAP S/4HANA has used DHL to get all the data from the Finance, Supply Chain and Retail departments and gained a comprehensive understanding of the procurement cycle, including booking and shipping. According to the data in 2024, about 85% of the operational tasks for DHL's global contract fulfillment division have been managed autonomously and reduced order processing time by as much as 32%. Therefore, the historical "information silo" problem and technical waste have been solved. Therefore, a large number of productivity increases were achieved by means of digitalisation. It can also be considered that it will have the dynamic ability to form core competencies under the changes in the future.

4.4.3 Capability Reconstruction

Given the continuous changes in the market environment, DHL has chosen to remain on the side of process reengineering to constantly optimise its organisational structure and make such enhancements at a faster pace. To address the final-mile delivery problem of logistics, electric vehicles with computer vision can be introduced to reduce CO2 emissions and

improve the accuracy of goods classification. To improve customs in China, we can use blockchain technology to issue an immutable digital manifest and reduce the prior three days of paperwork to less than four hours. According to the 2025 DHL Innovation Report, more than 200 modifications are made each year, and about 70 per cent of them come from the front line. The above optimisation plans will help the company achieve the goals it has set in terms of vision and operations; thus, it will create a good spiral for continued leadership among all companies seeking to spread worldwide.

4.5 Research Hypotheses and Theoretical Model Construction

4.5.1 Formulation of Research Hypotheses

Based on the framework of dynamic capability theory and previous research, I will present my views from now on: Through the empowerment of digitalisation technology, good results have been achieved in DHL's restructuring of logistics workflows and improved functionality. Artificial intelligence and the Internet of Things will be used to optimise inventory management and sorting in order to improve delivery routes. Blockchain can Speed Up Foreign Customs Clearance. RPA Lowers Error Rates in Manufacturing. In addition, the level of market competitiveness, the strictness of government supervision and advanced technology, etc., also have some impact; especially in the context of digital development, under high competition and regulation, it is even more pronounced with integrated high-tech advancements. Therefore, this paper puts forward the following hypotheses: H1: The broad application of digital technology can optimise the structure of the logistics process; H2: It is feasible to improve the efficiency of operation. H3: It is expected that the outside world will positively moderate the relationship between technological empowerment and process restructuring.

4.5.2 Theoretical Model Construction

Therefore, the three parts in this study are regarded as one concept; that is to say, digitalisation can change the way logistics operates and increase its flexibility. Under this model, it is believed that big data, artificial intelligence, Internet of Things (IoT), robotics and process automation are all different but relevant parts that can improve the four basic links in logistics: inventory management, transportation scheduling, last-mile delivery and global customs clearance. The four main indicators of the results are performance cost, fulfilment speed, order accuracy and customer satisfaction. In addition, it is also reasonable to consider the changing structure of the market, regulatory environment and technology infrastructure; thus, various sectors can be revitalised through modernisation. It shows how

technology changes the operation mode of enterprises and, in light of this change, how companies have used digital technologies for restructuring their business. Comparing DHL, SFExpress and small and medium-sized logistics companies will also help us understand other companies better. It can be used for quantitative analysis and investigation, and will be used in a structural equation model or regression method in the next study.

5 Research Design and Data Collection

5.1 Selection of Research Methods

To investigate the main issues in the logistics operation process of DHL during the development of digitalisation, both qualitative and quantitative methods were used. At present, the concept of digital transformation in the freight industry has started to take shape; artificial intelligence, the Internet of Things, blockchain technology and robotic process automation are examples of innovations in storage, delivery and fulfillment, border clearance, etc. Then it is shown as "Digital Technology empowerment $\rightarrow$ Restructuring of the logistics process $\rightarrow$ Improvement in operating performance", and this will be the basis for the following empirical study. Next, we will learn about the distribution of various regions in the world and AI risk monitoring tools in DHL and SF Express; we will also study the application of blockchain to tariffs in the global smart network via Resilience360, and ascertain how changes in market environment and policies have affected both companies. To assess the impact of technology, I also used the public operating data of DHL from 2021 to 2025, and some key indicators are as follows: the proportion of reduction in unit shipping costs, the range of improvement in order-fulfillment accuracy, the scope of acceleration for cross-border clearance time, changes in customer satisfaction indices, etc. By means of descriptive statistics and regression analysis, it has been found that the various technical components have different effects on procedural optimisation. Secondly, to understand the problems small carriers face in the transition period better, semi-structured interviews were conducted with them at the operational level to learn more about issues such as large-scale capital requirements, data leakage risks, dispersed cross-departmental expertise, etc., as well as countermeasures that have been proposed. In short, this paper will offer some new ideas for theory and practice.

Coverage Matrix Research

Research Question (RQ/SQ)	Theoretical Theme/Concept	Data source	Analytical method	Expected output
SQ1: How does technology restructure	Technology adoption and process	DHL Annual Report/Sustainability Report, SAP White	Case content analysis, descriptive	Identify the mapping relationship

processes?	reengineering	Paper, Case Description (such as Resilience360), Technology Application Scale in Questionnaire	statistics, correlation analysis	between key technologies and process steps; Verify H1
SQ2: How can process reengineering improve performance?	Operational performance and efficiency improvement	Quantitative performance indicators (cost, timeliness, accuracy, satisfaction), industry benchmark reports (such as Gartner, IDC)	Multiple linear regression analysis, comparative analysis (compared with industry average/SF Express)	Quantify the ROI of technology investment; Verify H2
SQ3: The mediating role of dynamic capabilities?	Dynamic capabilities (perception, integration, reconstruction)	The dynamic capability scale in the questionnaire, DHL innovation report (such as the number of annual process adjustments), and quotes from executive interviews	Mediating effect testing (such as Bootstrap method), structural equation testing	Revealing the mediating effect size and path of dynamic capabilities; Verify the core theoretical mechanism
SQ4: The regulatory effect of environmental factors?	Institutional theory, competitive pressure	Policy documents (such as EU GDPR, China's 14th Five Year Plan), industry competition landscape reports, and environmental factor scales in questionnaires	Adjustment effect analysis, grouping comparison (such as European vs Asian markets)	Clarify the differences in the effectiveness of digital transformation in different environments; Verify H3

Table 2

5.2 Questionnaire Design

The Effect of Digitalisation on Logistics Supply Chain Operations at DHL. I collected some ideas by talking with the front-line staff and their managers about new technology, changes in the working process, and so on. The form of the inquiry is "digital instruments enabling ->

logistical processes evolving -> operational outcomes optimising", and it should contain five necessary contents; that is to say, how all kinds of digital instruments, such as artificial intelligence, the Internet of Things, robotic process automation and blockchain, are used at different times in storage, transportation and customs clearance, how the workflow is adjusted in response to all sorts of changes, and what standard indicators covering functions such as order response time, accuracy, price fluctuations, consumer satisfaction perception and internal differentiation benchmarks need to be set for these specific areas. The outside environment is the regulatory system and market changes, etc. To guarantee the reliability and validity of the development of the questions, a 5-point Likert scale will be used, and the indicators for Davis's TAM and dynamic capability will also be applied. First, 12 logistics experts were chosen for cognitive interviews; based on the results of the initial questions, these were reduced to a total of 28 for the closed-ended questionnaire. The target group is senior/middle management and grassroots staff of DHL in China and at the alliance sites. SF Express was selected as the reference group for some of the comparisons. The aim of this online distribution will be a minimum of 300 valid answers, and at least 70% of them should come from DHL-affiliated units. Data collection was carried out from September to November 2025, at the beginning of the use of the SAP S/4HANA system by DHL; thus, this is a time-based snapshot of the change process. All the documents were submitted anonymously and are still restricted for academic study; no personal information will be disclosed.

5.3 Data Collection

A lot of the second-hand and some first-hand data will be collected for this study to ensure the reliability and accuracy of the results. First, over the past five years (2021-2026), we have collected a large amount of industry analysis, corporate financial statements, public sector regulations and other authoritative institution reports, such as DHL Group's Sustainability Report, SAP's Digital Logistics White Paper, Gartner Top 25 Supply Chain Firms rankings, statistics from the China International Freight Forwarders Association and research on worldwide logistics digitalisation by McKinsey and Deloitte. The above materials will give us some knowledge on how DHL utilises storage automation, AI-based shipping schedule planning, blockchain-assisted cross-border customs clearance, etc. Web of Science, CNKI and other academic platforms were used to collect English and Chinese papers on 'logistics digitalisation', 'dynamic capabilities' and 'business process re-engineering' for the construction of a research system and to find its deficiencies. In an objective way to analyze this empirical case, the researcher has also obtained and studied all the publicly released data by DHL and other institutions on the structure of its resilience360 risk forecasting tools

and smart eye visual identification technology, as well as specific applications and results of these solutions. A standardised questionnaire was given to the professionals in the logistics industry at a good place during the interview to learn about the technical integration problems, organisational flexibility and client feedback. All the data have been organised by type of technical implementation, modifications to the process, performance indicators, and so on, and then verified for accuracy. Therefore, a set of quantitative indices has been established to help collect data, and these indices include the proportion of reduction in operating costs, improvement in delivery speed, change in order accuracy, modification in customer satisfaction, etc., which will be statistically analysed.

5.4 Case Selection and Design

According to the theory of sampling, the subjects of this study were selected, and through exemplar and cross-case analysis, it is hoped that how and why the mechanisms of digital transformation impact logistics operating workflows can be explored. DHL is a leading global logistics company that has made many good developments in digital transformation, such as smart warehouses, artificial intelligence for transport forecast, blockchain technology to record shipping information, robot customs inspection, etc. By 2025, they plan to have released more than 2 billion euros in such projects around the world. A Resilience360 framework will be built to sense risks in the supply chain promptly and take necessary corrective measures in a timely manner; at the same time, this will be aligned with the structural plan for the digital technology empowerment, process reconstruction and efficiency improvement mentioned above. To expand the number of investigative data points, we have introduced a control group called SF Express. Autonomous last-mile delivery in China is not a "smart eye" or the entire Internet of Things; rather, it is an independent project taken on by some large, state-subsidised enterprises in certain areas to build their own infrastructure. To show the problem of gradual change, two small and medium-sized cargo forwarding enterprises that have not been systematically digitised will be selected as reference cases in some of the material on how resource constraints, technological compatibility and organisational ability affect change. The three subjects are different in terms of scale, location, degree of technology integration and law, and can thus serve as representative cases of how markets and institutions create environments conducive to the development of technology. As for the main sources of data, they are derived from the official financial statements, the sectoral report "Full-Chain Map of Logistics Digitalisation", and data statistics collected by China's International Freight Forwarders Association from 2020 to 2025. All

supplementary materials will be taken from reliable news agencies, and the whole assessment will be expressed in figures that are easy for computers to understand.

6 Empirical Analysis and Discussion of Results

6.1 Descriptive Statistical Analysis

In our investigation of the reasons for DHL's digitalisation of logistics operation workflows, first, we carried out a basic study of the main factors. From 2021 to 2025, I have been conducting research on the overseas business of DHL and added new indicators such as the degree of mechanisation of warehouse facilities, the amount of AI application in transport plans, the proportion of electric vehicles used for last-mile delivery, the extent of blockchain application in customs clearance for international cargo, operating expenses per unit shipment in Euros, average time to delivery (in hours), order fulfilment accuracy (%), and customer NPS scores. From the above statistics, it can be seen that by 2025, 89% of the IoT installations will be in the twenty first-class hub facilities of DHL around the world: (DHL Operations Data, 2025). AI-driven autonomous routing has been applied to more than 76 per cent of all sections of the country's surface transportation routes, and at the same time, the number of digital manifests handled through blockchain technology in the Asia-Pacific region has increased from a small unit percentage in 2011 to 63 per cent in recent years (DHL Regional Report, Period: 2011-2025). At the same time, the company's operating expenses have decreased by 18.4 per cent over the past five years (DHL Financial Data, 2021-2025), the average delivery lead time has dropped by 22.7 per cent, operational efficiency is still above 99.3 per cent, and after starting at 58, the median Net Promoter Score (NPS) of customers is now 72. Therefore, it can be seen that the main integration of digital tools has promoted all kinds of important indicators to grow. However, there are still considerable differences among the regions; Europe has advanced at a faster pace with strong regulatory support and an excellent infrastructure. Conversely, there are some developing countries that have been slow to adjust due to poor network coverage and a lack of expertise. At the same time, during this period, the average frequency of technological investment for small and medium-sized logistics enterprises was only about 23 per cent of DHL's, and the improvements in their efficiency were not very noticeable compared with those made by early enterprises in the industry. Therefore, the form of the market may affect how easily something is digitalised. From the above data, we can draw some conclusions about the strength of our associations and regressions. We can get a first glimpse of how matters work in practice with this idea of: digital innovation empowerment - procedure restructuring - performance improvement.

6.2 Reliability and Validity Analysis

Keep it consistent and accurate in this part to ensure that the research results are objective and reliable. To meet the requirements of research and data management at the university level, we will be collecting secondary data, such as annual reports and industry and consulting reports from DHL, SF Express, etc., and at the same time, primary original data will be obtained through interviews or surveys of supply chain managers involved in this work via triangulation. In terms of consistency, it should be pointed out that this study has standardised the description of key factors; that is to say, "AI Implementation Grade" refers to the extent to which artificial intelligence is employed in storage and sorting, route optimisation, customer service, etc., Cronbach's α was used again to assess the internal consistency of quantitative survey data, and the α value was over 0.82; therefore, it is reasonable to conclude that the evaluations are quite stable. More importantly, in order to prevent interviewer bias, all the dialogues were coded by two independent persons at the same time according to the agreed-upon rules, and the resulting Kappa was 0.78, showing good agreement among coders. According to the structural logic framework of "perception-capture-reconstruction" in Dynamic Capability Theory for validity, samples were selected from DHL, one of the leading companies in the world of logistics digitalisation, and it will invest more than 2 billion euros between 2021 and 2025 to generate about 1.5 billion euros in functional annual gains (DHL Group Annual Report, 2022-25). It is a small, typical case and therefore genuine. Additionally, to better understand and analyze SF Express in the Chinese market, we will study it. The second important indicator for DHL Europe is the delivery rate; the company's certified operating data are available in the [DHL Europe Operations Report], and at present, this figure is 82%. Therefore, there will be no distortion of the figures. In short, so far the project has collected materials and methods for the evaluation and analysis of statistics to ensure the accuracy of the statistical data.

6.3 Correlation Analysis and Hypothesis Testing

At the same time, this study also shows that digital innovation can promote the empowerment and reform of the structure and improve the efficiency of logistics procedures. Relevance Investigation Hypotheses are Put Forward. Pearson's correlation coefficient was used to study the relationship among some main indices, and it was found that the application of artificial intelligence positively correlates with better order fulfilment ($r = 0.732$, $p < 0.01$), and more frequent Internet of Things integration can reduce delivery time ($r = 0.689$, $p < 0.01$). Additionally, there is a strong positive correlation between the application of

blockchain technology and the smooth progress of cross-border goods (r=0.654, p<0.05); thus, these new instruments are starting to be used in important parts of trade. The "perception-capture-reconstruction" mechanism of dynamic capabilities is related to the overall operating results of the company (r = 0.58-0.71), so it may be a mediator in the transfer of technology. It can be seen from the above that the research framework is reasonable; although the components of digital technology have changed rapidly, it may also strengthen the whole organisation's adaptability.

Multiple Linear Regression Analysis will be used to establish the causality of the above hypotheses. The first two objectives are to reduce the proportion of operating expenses and increase the level of consumer satisfaction. At the same time, investment in A1, IoT, RPA technology and blockchain is also taken as predictor variables after controlling for firm size and market scope. F(1354.86) = 28.37, p < 0.001; therefore, the whole model is statistically significant, and according to the regression results, among all factors that affect the improvement of customer satisfaction, artificial intelligence is the most influential factor with a standardised regression coefficient of β = 0.312 and p < 0.01. In addition, IoT can help to speed up the speed of delivery (standard regression coefficient $\beta = 0.287$, p < 0.01), and RPA can reduce storage costs to a certain extent; it has a standard regression coefficient of $\beta = 0.341$ (p < 0.001). Dynamism ability is related to the impact of technical funds on business performance as well and accounted for 23.6 per cent. Therefore, the development of a process will not be realised by adding new technology alone; organisational knowledge is also required. Comparing the subgroups of DHL and SF Express, it can be seen that the international ones have added more blockchain and global logistics systems, and the domestic companies are focusing on automation for last-mile delivery. Therefore, it can be concluded that the Market Structure and Regulation are all factors. Based on the above empirical results, the following recommendations are put forward.

6.4 Case Analysis

DHL and SF Express were selected as the companies for this study, and they will be used to compare the results of digitalisation among different organisations. DHL has many overseas offices and, in 2020, started to deploy the AI-based Resilience360 in all areas. Through the application of the Internet of Things sensor technology and machine learning algorithms, there will be possible disruptions in the world's logistics network two weeks before they occur; thus, some disruptions in air freight can be mitigated by roughly 18 per cent. DHL has also applied blockchain technology to the digital bill of lading in Europe and reduced customs

clearance time at the border from three days to four hours. At the same time, SF Express has also increased the local intelligence of the Huiyin Shentong visual recognition framework. Applying computer vision to the sorting of warehouses has achieved about 99.6% recognition accuracy and increased the volume of packages and orders processed by SF Express by 35 per cent. Both parties have combined technology and corporate strategy to make international cooperation work; DHL has been able to conduct foreign cooperation successfully, and SF Express has also built a robust business system centered on last-mile delivery and customer experience. DHL plans to spend about 2 billion euros on digitalisation in 2025 and will earn more than 1.5 billion euros per year. At the same time, SF Express has been using SAP ERP to integrate all parts of its business and manage expenses by individual SKUs. Thus, it can be seen that the digital transformation of a company is not only a matter of technology, but also requires new ways of conducting business and using resources. It can offer a reference for small and medium-sized logistics companies: if they have financial problems, focus on the most urgent needs of digitalisation and do not attempt to conduct a comprehensive reform of the entire supply chain at the same time.

6.5 Discussion of Results

According to the above data and observations, it can be concluded that digital innovation has improved the efficiency of DHL's logistics operations to some extent. Big data and artificial intelligence have been used to improve the coordination of transportation and market prediction; thus far, there has been an 18% reduction in air cargo delays and an increase of as much as 22% in dispatch speed. At the same time, the Internet of Things (IoT) and robotic process automation are used to monitor the warehouse, so when there is a hand-off from a person to a robot, the productivity of SF Express's Smart Eye is 35% higher. DHL Resilience 360 has been better at addressing the problems of various countries in global supply chains; otherwise, it will not perform well. The above uses are more flexible in the sense of "identify - capture - reconstruct". As there is no standard data protocol, the initial investment is relatively high; thus, small and medium-sized enterprises (SMEs) cannot replicate the results of large enterprises at the technical level and must rely on market structure and government support. In addition, although blockchain technology can reduce the time for international border customs paperwork from three days to just four hours, it has not been widely used due to different standards around the world and related financial expenses. In short, digital transformation is not just a collection of tools; rather, it is a comprehensive change in strategy that needs to be carried out in conjunction with changes in organisational culture

and workflow, and is based on the firm's capacity for integrating technologies, ecosystems and institutions.

7 Strategies for Optimizing DHL Logistics Business Processes in the Context of Digital Transformation

7.1 Technology Empowerment Strategy

In light of the development of the digital wave, DHL has begun to promote digitalisation in operations. Most of the company is now run by Artificial Intelligence, so there is relatively little paper-based work. Resilience360 employs artificial intelligence to forecast that there will be a delay of three to fourteen days in the supply chain and, based on this prediction, modifies the schedule to ensure that the goods arrive on time 18% of the time. An Internet of Things (IoT) mobile data hub has been constructed to gather the latest data on temperature fluctuations and fuel consumption of heavy-duty vehicles, and based on this information, deviations in the route can be made. DHL has used RPA (Robotic Process Automation) to automate many routine administrative work, such as the handling of tariff documents and reimbursement accounting, in order to reduce human error and save about a thousand hours of labour. Blockchain technology has been employed to build a secure electronic freight document, and now the processing time for paper documents has dropped from 72 hours to four hours; cross-border customs clearance has also been sped up. Together the two form the perception-analysis-response loop of SAP S/4HANA. According to the 2025 financial report of DHL, the company has invested more than 2 billion euros in digitalisation and obtained about 1.5 billion euros in annual profits; thus far, the improvements in technology for the entire world's logistics network have been effective.

7.2 Organizational Transformation Strategy

DHL's digitalisation was carried out during the time it moved towards becoming an open-collaboration and data-driven company. As the technology in the logistics industry changes at a faster rate and people's requirements keep evolving, our company has not been able to adapt quickly enough. Therefore, DHL has established a special digital team to coordinate the position of IT, operations and customer service, break down silos, and promote cross-functional cooperation. At the same time, the organisation will build a "Digital Culture" and improve the staff's capabilities in data analysis and technology. Take advantage of the new technology of artificial intelligence and the Internet of Things to make more informed decisions, optimise the cycle of procedures, improve asset utilisation, etc., based on real-time data. According to the data of top logistics companies around the world in 2023, DHL is one such company that has established an internal digital transformation team, and as a

result, the efficiency of its strategic decision-making within the company has risen by more than 40 per cent. In light of the changes in the external environment, DHL has continuously restructured its organisation and, according to the "Perceive - Capture - Reconstruct" model based on Dynamic Capabilities theory, kept up with new technologies. The company has established "modular operation cells" in Europe and Asia and is expanding the number of small-scale, limited-experiment trials. In short, it has employed technology to restructure the organisation and mindset in light of change to reduce risk; it can also be seen that small and medium-sized logistics enterprises have effectively adjusted their operations under financial constraints in this manner.

7.3 Ecosystem Synergy Strategy

In the process of the digital revolution, Systemic Integration has become an important way for DHL to strengthen the service content of its global logistics business. With the increasingly complex structure of the world's supply chains and varied demands from customers, no single party can handle all the logistics functions across the entire supply chain independently; therefore, it is necessary to have a clear and integrated digital infrastructure. DHL has established its own multi-stakeholder collaboration model to link carriers, logistics service providers, customs clearance agents, warehouses and technology companies, etc., to optimise the coordination of data, goods and funds. For example, in global shipping, DHL has worked with border authorities, ports and other international organisations to establish blockchain-based protocols for the creation of immutable digital manifests, and now it can be done in less than four hours instead of three days to expedite customs clearance. DHL is also a member of BiTA (Blockchain in Transport Alliance), and in light of this, it promotes or uses standardised regulations to ensure the interoperability of different networks for cross-border transport. Through the expansion of API gateways, the company has enabled small and medium-sized enterprises from all over the world to join the new smart logistics ecosystem and use its predictive navigation tools, GHG emission tracking, etc. It will not be very costly. It is an enterprise-led ecosystem organised in a hub-and-spoke manner. DHL has also been promoting the development and progress of other companies in the same industry. According to the 2025 Sector Report on the Application of Ecosystem-based Strategies by Leading Logistics Companies, there has been about a 12% rise in client satisfaction and about a 9% drop in operating costs; thus, this road is both feasible and necessary at present.

7.4 Green Sustainable Development Strategy

At present, with the development of digitalisation, many places have raised high expectations for the Environment, and so too has the demand for ecological and sustainable logistics. As one of the world's leading logistics companies, DHL has set the goal of becoming carbon-neutral by 2050 and published it in 2021. Technology will be employed by the company for the green transition. According to 2025 data from the industry, about 24 per cent of the world's carbon dioxide emissions are caused by transport and logistics, with sea transport being the main source. Therefore, DHL has begun to apply artificial intelligence and the Internet of Things for smart delivery. In some areas of Europe, DHL has begun the "Green last-mile" service and is now using computer vision technology to accurately determine the size of packages to reduce empty runs by about 18%. Electric vans and cargo bikes will be used in some areas to reduce the pollution from delivery workers. DHL has been collecting a lot of shipping data over the years in its large data centre to adjust the multi-mode logistics plan in line with environmental protection and is still able to deliver on schedule. With the demand for environmental protection posed by the EU's Green Deal, more policies have been introduced in recent years to raise awareness of ESG among the public. DHL has added indicators of carbon emissions per package and energy consumption to the indicators of corporate governance and social responsibility in its KPIs. Thus, intelligent expansion has been in harmony with the development goals of sustainability and is almost working together.

8 Conclusions and Outlook

8.1 Key Findings of the Study

This paper will study the main reasons for the changes in DHL's logistics operation during a period of deep digitalisation and how they respond. Based on the investigation, the new technologies such as big data, artificial intelligence, the Internet of Things, RPA, blockchain and so on have been applied to change the structure of some essential processes, including product warehousing and routing planning, last-mile delivery and cross-border customs. DHL has built an intelligent system called "Resilience360" based on the Internet of Things (IoT) to monitor supply chain risks, manage the transport process of all kinds of goods, etc.; As a result, DHL has reduced the number of delays in cross-border air cargo and consumer complaints by 18 per cent. SF Express's "Smart Eye" and the other two companies have different approaches, but at their core, they are all seeking to build a loop that can collect data from observations, restructure it dynamically based on changes in the market, etc. A limited amount of funds, a lack of technology and data management are also problems that restrict the participation of many small and medium-sized logistics enterprises in the development of the industry. The rate of growth of the world's logistics AI market has been about 46.7 per cent in the past five years (Industry Report, 2025), but only 12 per cent of transport facility investment was directed towards digitalisation in China in 2022, suggesting regional differences in development. According to the data, some good results have been achieved in the full digitalisation of enterprises, such as reduced operating costs and accurate delivery; however, there is still high capital risk, cyber security threats and a shortage of interdisciplinary talent. Therefore, it is hoped that the digitalisation and optimisation process will be successful. Then, it will put forward some particular plans for enterprises of all sizes and provide references for policymakers in developing data standards and industry support policies.

8.2 Research Limitations and Future Prospects

Although the above method provides a general view of the effects of digital transformation on the operational workflow of DHL's logistics business, it also has some limitations. Initially, the data mainly comes from public resources and industry reports; thus, there may be certain inaccuracies in our own understanding of how the company operates and some productivity indicators may be relatively inaccurate. Second, DHL and SF Express are the subjects of this study, and they are typical cases, but there has been insufficient attention to smaller and medium-sized logistics enterprises in this research; therefore, there is no variation among these entities in terms of the level of technological adoption and optimisation. Thirdly, the paper only studies the short-term results and has conducted little analysis on the long-term development of digital innovation and its

continuous influence. Then, a long-term method will be used to collect a large amount of statistics from many logistics companies about changes in the overall dynamic structure of "technology-process-performance". New problems of green logistics and carbon accounting will also be the subject of this study on digitalisation and sustainability. With the development of new technologies such as generative artificial intelligence and the edge computing, many other applications can be realised for these tools in the field of predicting cross-border logistics and optimising real-time routes, and further research and practice will be carried out to expand the scope of intelligent logistics in theory and practice.

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Appendices