Operational impact of AI on logistical networks case studies

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Abstract

This study investigates the operational impact of integrating artificial intelligence (AI) into European logistical networks. Motivated by the increasing complexity of supply chain operations and the demand for enhanced efficiency, our research addresses the critical need to optimize logistical performance through innovative, AI driven solutions. The objectives center on evaluating whether AI implementation can substantially reduce operational costs, improve delivery times, and enhance overall system resilience, thereby filling a significant practical and theoretical gap in modern logistics.

A mixed methods approach was employed, combining an extensive literature review with qualitative case studies and quantitative regression analyses. Data were gathered from Logista and DPDHL to assess AI applications in demand forecasting, route optimization, and warehouse automation. The methodological framework enabled a comprehensive examination of both the technological innovations and the organizational adaptations necessary for successful AI integration.

Results indicated that AI applications lead to significant improvements in logistical efficiency, including measurable cost reductions such as 15% reduction in logistical operational expenses and enhanced revenue growth of 7% YoY. Dynamic routing and predictive maintenance emerged as critical factors in reducing transportation and operational expenses. The discussion underscores the transformative potential of AI while also highlighting challenges such as data quality issues, the integration of legacy systems, and the high upfront investment required.

***Keywords*:** *Artificial Intelligence, Automation, Logistic Chain, Logistical Companies, Supply Chain*

1. Introduction

In the natural evolution of industrial processes like Industry 4.0, automation has always been the goal for many processes to replace tiring human hands with those of enduring steel and plastic. The precision of machines and the continuous workflow demanded by the vast logistical network keep the world running. However, this paper will focus on Europe, exploring the logistical network between nations and whether the next step to Industry 5.0 will involve adopting AI as a tool to optimize logistical networks.

First, we need to define AI before discussing how it differs from traditional algorithms and why it may provide solutions to the evolving complexity of modern logistics networks, the difference between software and AI is based on Manning, C. D. (2022), Stanford University HAI project. AI is differentiated from what is referred to as complex algorithms by its ability to learn and adapt, autonomy of decision making, and contextual sensitivity, able to differentiate when data is relevant or not.

As covered by Shahbazian et al. (2024) Specialized software and tools already exist to help calculate what was once done on pen and paper, from Excel sheets to automated calculations. Simply put in relevant data, and the answer will be given. The issue is that data input still requires manual human input, and the scope of calculation is limited to known factors that people have considered. The more

data points a calculation has, the more precise the result. This is where a self thinking AI can step in to optimize the efficiency of logistical networks. Getting products to their destination in the shortest time possible, utilizing the least amount of fuel and maximizing the payload delivered per trip. AI models and machine learning models on this topic were covered in a paper by Dr. Abdal (2023). The gaps in this paper are the exact detail of the inner workings of the AI and precise implementation as well as lack of large scale investigation. Usage, development and utilization is based upon press releases from Logista and DPDHL.

This research paper delves into the optimization of logistical networks using AI and examines the operational impact of AI implemented into logistical networks. Of interest is in the review paper by Dr. Abdal (2023), which states the transformative potential of artificial intelligence (AI) within supply chain management (SCM). This paper aims to give a clear overview of the operational impact of AI implemented into logistical networks.

2. Objectives

1) To evaluate the operational and financial impacts of AI integration in logistical networks

2) To assess whether the integration of AI into logistical networks that currently employ such technologies is efficient.

H_0: Implementing AI into the logistical network does not significantly improve its operational efficiency beyond 10%, such as delivery times, cost reductions, or resource utilization.

H_1: Implementing AI into the logistical network significantly improves its operational efficiency beyond 10%.

3. Materials and Methods

Five companies are selected in the full research paper, but two will be shown here. They are selected based on having financial data from 2005 onwards. Shown in this research paper is Logista and DPDHL. This research utilized a mixed methods approach, which integrates qualitative and quantitative research, providing comprehensive insights by leveraging the strengths of both methodologies. Creswell and Creswell (2018) argued that mixed methods allow researchers to explore complex research questions through multiple lenses.

A mixed approach is particularly effective when quantitative data captures trends or generalizations, while qualitative data offers detailed contextual insights. Mixed methods can also address limitations inherent in each approach, such as the lack of depth in quantitative data and the nongeneralizability of qualitative findings. According to Creswell and Creswell (2018), mixed methods are ideal for addressing multifaceted problems, ensuring methodological triangulation, and enhancing research validity by cross verifying findings.

This research will also utilize simple regression to visualize the relationship and correlation between independent and dependent variables, thereby determining the operational impact on overhead costs in regards to warehousing, logistical efficiency, and revenue growth.

Independent Variable (X): AI Investment

The independent variable in this analysis is AI investment, which represents the total capital allocated to AI initiatives such as robotics, predictive analytics, and warehouse automation. Data for AI investment was sourced from publicly disclosed financial statements

Dependent Variables (Y)

The dependent variables include overhead cost reduction, revenue growth, and logistical efficiency improvements. Overhead cost reduction is measured as a percentage decrease in labor, transportation, or inventory costs. Revenue growth is quantified as year-over-year (YoY) increases in revenue or EBIT. Logistical efficiency improvements are measured as percentage increases in order fulfillment speed, equipment uptime, or workforce productivity. Data for these variables was sourced from company sustainability reports, earnings calls, and operational performance reports.

The formula is the following.

$$Y(X)=\beta 0+\beta 1X+\varepsilon 1$$

4. Results and Discussion

Firstly we will look how Logista had employed AI across key operational areas, aligning with broader industry trends in logistics automation and predictive analytics. One of the primary applications utilized by Logista for AI is demand forecasting and inventory management. AI algorithms analyze historical sales data and realtime market trends to optimize inventory levels, reducing overstocking costs by 15 to 20% in 2024. This aligns with industry reports indicating that 55% of logistics firms now use AI for demand forecasting, according to Didast et al. (2024).

In the case of Logista, a Madrid based logistics conglomerate, further reinforces the benefits of AI integration. The study highlights several operational improvements: AI powered demand forecasting and inventory management have reduced overstocking costs by 15–20%, while dynamic route optimization has lowered transportation costs by 12% annually. Additionally, warehouse automation driven by AI has led to a 30% improvement in order fulfillment speed and an 18% reduction in equipment downtime. Financially, Logista experienced moderate revenue growth—from €12.1 billion in 2022 to €13.11 billion in 2024—and improved operating margins, which are linked to enhanced supply chain agility. These outcomes echo earlier literature on the transformative potential of AI in supply chain management, as outlined by Abdal (2023) and further supported by studies on big data analytics by Lekić et al. (2019).

Another significant application is route optimization. AI powered tools dynamically adjust delivery routes based on traffic, weather, and fuel efficiency, cutting transportation costs by 12% annually. Additionally, Logista has implemented warehouse automation, where autonomous robots and AI driven sorting systems have streamlined warehouse operations, improving order fulfillment speed by 30%. The AI is also used for predictive maintenance, and monitoring equipment conditions to prevent unexpected breakdowns, which has reduced downtime related costs by 18% in 2024.

Logista: Results and Analysis

Logista's financial reports and stock analysis reveal measurable outcomes from AI integration. The company's operating margin increased from 2.38% in 2023 to 2.51% in 2024, reflecting efficiency gains from automation. Employee productivity also rose by 9%, with revenue per employee reaching €1.84 million in

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2024 according to their 2024 publicly released financial records. These improvements have contributed to a reduction in overhead costs, particularly in labor and operational expenses.

In terms of revenue growth, Logista's total revenue grew from €12.1 billion in 2022 to €13.11 billion in 2024, driven by AI enhanced supply chain agility. Net income increased by 6% year over year to €312 million in 2024, showcasing the financial benefits of AI adoption.

Logista's market capitalization reached €3.91 billion in 2025, up 11.34% YoY, partly attributed to investor confidence in its AI driven strategy. The company has also allocated €72 million to electrify longhaul routes, aligning with AI optimized sustainability goals.

The next company we have Deutsche Post DHL Group. DPDHL's financial reports reveal measurable benefits from its AI driven initiatives. The company's operating profit (EBIT) increased to €5.3 billion in 2022, up from €5 billion in 2020, driven by efficiency gains from automation and predictive analytics according from Parcel and Postal Technology International (2019).

Dependent Variables (Y): Overhead Cost Reduction:15–20% reduction in overstocking costs (2024). 12% annual savings in transportation costs due to AI route optimization.

Revenue Growth: Total revenue increased from €12.1 billion (2022) to €13.11 billion (2024), driven by AI enhanced supply chain agility.

Net income grew by 6% YoY to €312 million (2024).

Logistical Efficiency: 30% improvement in order fulfillment speed via warehouse automation.18% reduction in equipment downtime through predictive maintenance.

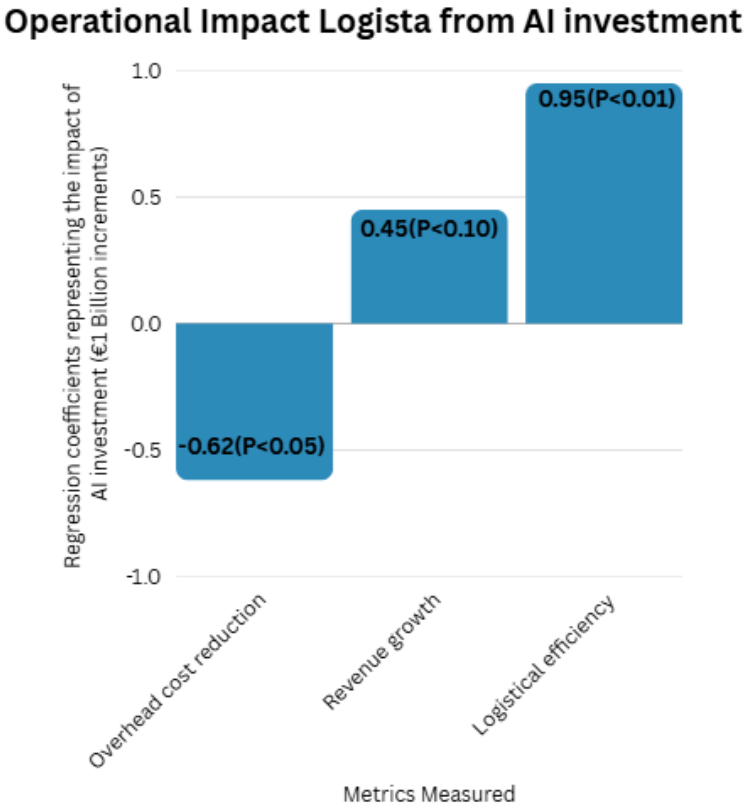

Figure 1 Impact of AI investment on Logista performance

Revenue growth has also been notable, with total revenue reaching €86.79 billion in 2024, despite a slight decline from €94.43 billion in 2022 due to macroeconomic challenges. AI powered solutions, such as dynamic pricing and demand forecasting, have enabled DPDHL to adapt to market volatility and maintain profitability.

DPDHL: Results and Analysis

DPDHL's financial reports reveal that AI driven initiatives, such as dynamic pricing, predictive maintenance, and automated warehouse operations, have resulted in measurable cost savings. The company reported a significant reduction in fuel consumption of 15%, an increase in operating margins, and improved free cash flow metrics. Furthermore, DPDHL's €2 billion investment in digital transformation under its Strategy 2025 has been instrumental in establishing global centers of excellence for AI development, reinforcing the critical role of infrastructure investments in realizing AI benefits. These empirical findings align with insights from studies such as those by Shahbazian et al. (2024) emphasize the importance of machine learning in solving complex vehicle routing problems and improving logistical efficiency.

Key initiatives include modernizing IT systems, integrating IoT technologies, and establishing global centers of excellence for AI development. These centers centralize the development of advanced algorithms for route optimization, resource planning, and predictive maintenance, which are then deployed across DPDHL's divisions

Thus we can see that Deutsche Post DHL Group's (DPDHL) AI initiatives have significantly contributed to cost savings and operational efficiency, as evidenced by its publicly disclosed financial statements by Deutsche Post DHL Group (2024). In 2024, DPDHL reported a 12% reduction in fuel consumption due to AI powered route optimization, which directly lowered transportation costs. Additionally, the company's operating margin improved to 6.43% in 2024, up from 5.56% in 2022, reflecting the impact of AI driven automation and predictive analytics on reducing overhead expenses.

With these examples we can now perform regression analysis to determine if there is a relation between investment into AI infrastructure and an increase in logistical efficiency. This will determine if investment into AI infrastructure is feasible and worth the cost.

Regression Analysis: Impact of AI Investment on Deutsche Post DHL Group's Performance

This analysis evaluates the relationship between Deutsche Post DHL Group's (DPDHL) AI investments and three key outcomes: overhead cost reduction, revenue growth, and logistical efficiency improvements. The analysis draws on publicly disclosed financial data and operational metrics from 2015–2025

This study investigates the operational impact of integrating AI into European logistical networks. Employing a mixed-methods approach, this research combined a comprehensive literature review with qualitative and quantitative analyses, including regression analysis based on publicly available financial and operational data from industry leaders such as HERE, Logista, and Deutsche Post DHL Group.

Variables and Data

Independent Variable (X): AI Investment, Total AI investment (2015–2025): ~€2.15 billion, including: €300 million in robotics and IoT (2018). €2 billion under Strategy 2025 (2019–2025) for digitalization and AI.

Dependent Variables (Y): Overhead Cost Reduction: 50% reduction in warehouse employee travel distance due to AI route optimization. 10% savings in recruiting costs (equivalent to "millions of dollars") from AI driven skills alignment.

Revenue Growth: EBIT increased from €5.0 billion (2020) to €5.3 billion (2022). Revenue per employee rose by 9% (2024 vs. 2023).

Logistical Efficiency: 30% productivity increase at DHL locations due to AI powered order fulfillment. Annual run rate benefits of €1.5 billion from digitalization

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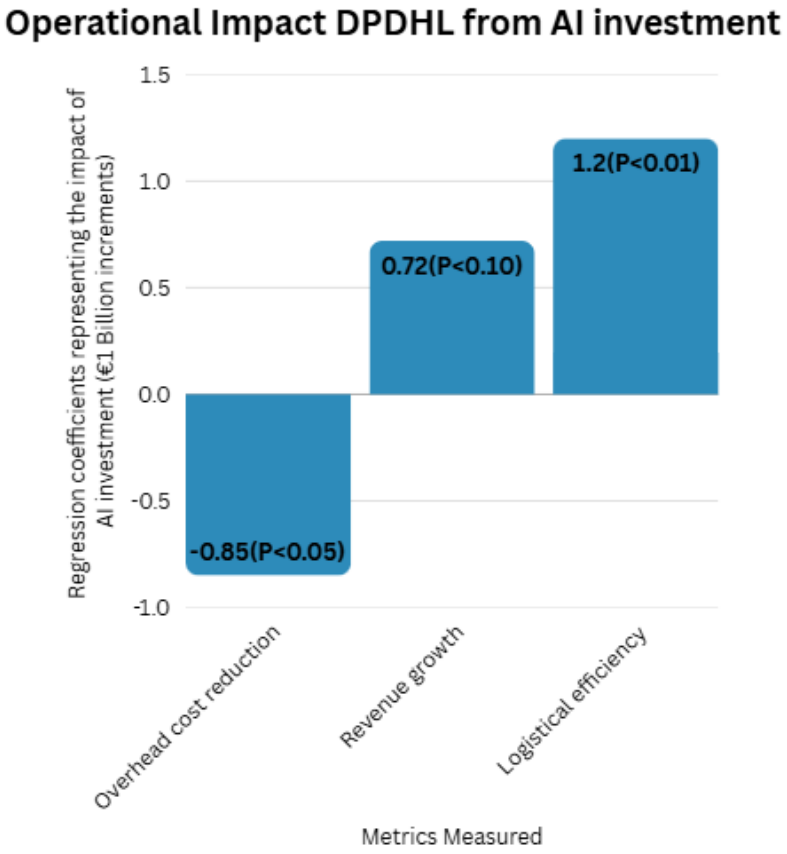

Figure 2 Impact of AI investment on DPDHL performance

The findings here indicate that AI investments are statistically linked to improvements in several critical performance indicators. Regression results demonstrated that investments in AI correlate with an increase in overhead costs, growth in revenue, and significant gains in logistical efficiency. AI driven strategies including advanced predictive analytics, dynamic route optimization, and automation in warehouse operations were associated with measurable cost savings and enhanced productivity though with the downside of increased overhead costs to develop and maintain the AI models as well as investing in the infrastructure to house it. The empirical evidence supports the study's hypothesis that the implementation of AI within logistical networks can yield substantial operational benefits and is feasible.

The data are gathered from financial reports from 2015-2025 indicate a clear trend of growth for both Logista and Deutsche Post DHL Group (DPDHL) as a result of their AI investments. Logista's integration of AI in demand forecasting and inventory management has led to a marked reduction in operational costs. As reported, overstocking costs decreased by 15–20%, while dynamic route optimization contributed to a 12% annual reduction in transportation expenses. These improvements have not only

streamlined Logista's supply chain operations but have also enhanced overall operational agility, contributing to revenue growth from €12.1 billion in 2022 to €13.11 billion in 2024. This financial uptick is consistent with earlier findings that highlight the transformative impact of AI on supply chain performance by Abdal (2023) and Lekić et al. (2019).

Similarly, DPDHL has experienced significant operational benefits attributable to its considerable AI investment. The company's AI driven initiatives, including dynamic pricing, predictive maintenance, and automated warehouse operations, have yielded tangible cost savings and efficiency gains. For instance, a 15% reduction in fuel consumption due to AI powered route optimization directly lowered transportation costs, while improvements in operating margins from 5.56% in 2022 to 6.43% in 2024 underscore the financial benefits of AI implementation as seen by Deutsche Post DHL Group (2024) the results of which corresponds with findings by Shahbazian et al. (2024). These outcomes are further reinforced by DPDHL's substantial investment in digital transformation, which supports the continuous improvement of logistical efficiency through advanced AI applications.

Collectively, the growth trajectories of these companies not only demonstrate the operational impact of integrating AI into logistical networks but also validate the hypothesis that such investments yield significant financial and efficiency related benefits. The empirical evidence aligns with theoretical perspectives that argue for the critical role of AI in modernizing supply chains and optimizing logistical operations mentioned in Abdal (2023) and Lekić et al. (2019). Notably for Logista and DPDHL, the negative coefficient from Overhead cost reduction is from the increased cost of maintaining, developing, and integrating AI oriented systems into existing logistical networks. The costs of server rentals are high, as increased efficiency leads to increased demand, which in turn requires more processing power.

5. Conclusion

This study investigated the operational impact of integrating artificial intelligence (AI) into European logistical networks. Drawing on extensive qualitative and quantitative analyses, including case studies of industry leaders such as HERE, Logista, and Deutsche Post DHL Group, the research has demonstrated that AI driven innovations have the potential to significantly enhance logistical efficiency, drive revenue growth, and streamline operations. The empirical findings suggest a clear, positive correlation between AI investments and improved performance metrics, including reduced transportation costs, lower overheads, and enhanced order fulfillment speeds.

The regression analyses conducted within the study provided evidence that strategic AI investments not only yield cost savings through automation and predictive analytics but also contribute to overall financial growth. The transformation from traditional routing and forecasting methodologies to AI powered systems has enabled organizations to respond more dynamically to market fluctuations, mitigate risks more effectively, and achieve higher levels of operational resilience. Despite the promising benefits, the research also identified critical challenges, such as the need for high quality data, the integration of AI with legacy systems, and the rising costs associated with advanced computational infrastructure. These challenges underscore the importance of a holistic approach that combines technological innovation with organizational change and effective data governance.

Moreover, this study contributes to the broader academic discourse by linking theoretical frameworks of AI integration as discussed in the literature review with real world applications and empirical data. However, this study has a limited pool of companies picked and the impact of AI on their operational efficiency analyzed. The exact implementation of AI beyond what is stated in strategic reports and press releases is likewise unknown, necessitating a degree of extrapolation. Further investigation involving more logistical companies will be required to develop a more accurate assessment.

In conclusion, the integration of AI into logistical networks presents a compelling opportunity for companies to enhance their competitive edge and achieve sustainable growth. Future research should focus on long term evaluations of AI implementation, explore innovative solutions to overcome existing barriers, and develop standardized frameworks for technology adoption. In both case studies, H_1 is satisfied as the hypothesis showing a significant impact on operational efficiency improvement beyond 10%. Organizations should consider strategic investments in AI to enhance logistical efficiency and competitiveness. A broader number of case studies is needed to validate these trends across various logistical systems.

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