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The Impact of Artificial Intelligence and Big Data Integration on Decision-Making and Supply Chain Efficiency in Modern Logistics

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Abstract

This study examines the impact of the integration of Artificial Intelligence (AI) and Big Data on decision-making and operational efficiency in the logistics sector. AI accelerates data processing, while Big Data enables large-scale analysis to make more informed decisions. Both technologies can improve planning, distribution, and equipment monitoring, as well as enhance supply chain operability by reducing human error. The study included case studies of 50 logistics companies that have adopted AI and Big Data. Using this quantitative method, the research team developed survey questions based on the four parameters listed above and answered them by interviewing representatives from each company's management department. The results show that 70% of companies have implemented AI across various operational aspects. Sixty percent of companies are fully utilizing Big Data. AI improves demand forecast accuracy by 30% and reduces inventory waste by 25%. AI implementation saves 15-20% on delivery time in route management, while reducing operational costs. However, there are several drawbacks: it is expensive to build systems using all these technologies, there is a shortage of skilled labor, and companies struggle to integrate new systems with existing legacy systems. This study also shows that organizational readiness plays a critical role in leveraging the technical potential of these two technologies to improve supply chain operational efficiency.

Keywords:
Artificial Intelligence; Big Data; Decision-Making; Operational Efficiency; Supply Chain; Logistics.

1. INTRODUCTION

Digital technology has brought significant changes to many aspects of logistics, particularly AI and Big Data. AI's ability to process data quickly and accurately, combined with Big Data's ability to handle vast amounts of information, creates a clear winner: more data means better decisions. For the supply chain sector in general, the application of these two technologies can improve the ecological efficiency of unit status and react quickly to market changes. Today's supply chain desperately needs coordinated data management across multiple participants. The combination of AI and Big Data can optimize planning, monitor distribution of goods, and reduce operational decision-making errors. This study seeks to investigate the impact of these two technologies on decision-making and operational efficiency in logistics.

The integration of AI and Big Data has become one of the main drivers of digital transformation in the logistics sector. According to Duan et al. (2019), the development of AI in the Big Data era has changed the view of decision-making in many organizations. Algorithm-based systems are capable of processing large amounts of information in very little time and producing more precise decisions compared to conventional methods. The use of Big Data analytics in logistics helps companies to understand demand patterns, to reduce costs, and to improve safety planning. Where Govindan et al. (2018) stated that Big Data is important for

optimizing "routes, inventory and improving delivery times. Optimized with real-time data, organizations can from time to time re-alter operational strategies to changing markets. If changing to strategies. According to Zamani et al. (2022), the combination of AI and Big Data strengthens the supply chain through predictive analytics capabilities that detect potential disruptions early in a way that partially depletes the distribution network company and reduces operational processes and future instability. In addition to technological factors, organizational commitment is also an important aspect of the digitalization process. According to Saarikko et al. (2020), the success of digital transformation depends on the readiness of human resources, the ability to adapt to change, and leadership strategies that support innovation.

The use of big data supply chain analytics has become a crucial pillar of the efficiency and resilience of international logistics systems. Kache and Seuring (2017) point out that digital transformation in supply chain management offers significant opportunities for businesses to optimize processes, but also brings with it a host of challenges. The complexity of data integration, adequate digital infrastructure, and information security are key challenges. Big data analytics helps businesses more accurately understand operational patterns, predict consumer demand, and make more informed strategic decisions. Khan et al. (2022) assert that supply chain analytics plays a crucial role in improving company performance, especially post-pandemic. The Three Ages of Strategy: Agility, Alignment, and Adaptability enable businesses to quickly respond to market changes, reorganize under uncertain global conditions, and maintain the utility of supply networks. Structured data analytics enables companies to increase operational resilience without compromising profitability. Zhu et al. (2018) found that implementing supply chain analytics leads to greater operational transparency. By fully leveraging real-time, connected data across every step of their operations, companies can more accurately monitor every link in the chain, from planning to final distribution. This transparency helps partners better coordinate their business and also demonstrates to customers the reliability of the transportation system. The combination of big data analytics and supply chain analytics has a positive impact on efficiency, decision-making accuracy, and adaptability in today's increasingly complex business environment.

The use of Artificial Intelligence (AI) in the supply chain plays a crucial role in providing excellence and ensuring the stability of business activities. Belhadi et al. (2021) argue that AI-based innovations lead to improved performance through adaptability to market changes and distribution issues. By using AI-based technology, companies can process large amounts of data quickly. They can also detect potential disruptions early and adjust their operations accordingly. This research confirms that the use of AI plays a key role in stabilizing the supply chain during times of uncertainty. This approach can also significantly improve a company's inventory turnover ratio, thereby increasing its profit margin. For example, Seyedan and Mafakheri (2020) propose that predictive Big Data analytics enables companies to better understand market patterns and operational capacity in real time. The implementation of this technology reduces the risk of overstocking on one hand or shortages on the other, while reducing logistics costs and improving delivery accuracy. This technology contributes to overall efficiency improvements across the supply chain. Furthermore, Aljohani (2023) points out that predictive analytics, as a machine learning system, can help improve a company's real-time adaptability to changing market conditions. This integration provides companies with a faster response to disruptions through automated risk analysis focused on avoidance and ensuring sustainable operations. Machine learning-based methods can improve the effectiveness of coordination across all stages of the supply chain and accelerate administrative decisions. By combining Artificial Intelligence, predictive analytics, and machine learning in this way, we provide the foundation for transforming a future-oriented supply chain into one that is not only more resilient and efficient but also capable of sustainably addressing global change.

Advancements in digital technology have brought significant changes to the logistics sector, particularly through the implementation of Artificial Intelligence (AI) and Big Data. These technologies enable fast data processing and large-scale analysis, supporting more accurate and efficient decision-making. In the supply chain sector, both technologies have the potential to improve operations and accelerate responses to market changes. Many logistics companies face challenges in data management and coordination among stakeholders. The integration of AI and Big Data plays a key role in optimizing planning, distribution, and monitoring of goods, while also reducing errors in operational decision-making. This study aims to assess the impact of these two technologies on operational efficiency and decision-making quality in logistics.

2. RESEARCH METHOD

This study uses a quantitative approach with an experimental design and case studies to evaluate the impact of the integration of Artificial Intelligence (AI) and Big Data on operational decision-making or efficiency in logistics, with examples clearly illustrating each step. This study focuses on measuring the extent to which these technologies can improve operations management performance, according to Listy et al. (2025). Data were collected through a questionnaire survey of companies in two regions that implement AI and Big Data in their operations. Those who responded to the questionnaire included operations managers, data analysts, and decision-makers in logistics operations. The questionnaire used in this study

was designed to determine at which operational stages these technologies are implemented, such as how they are used in demand planning, supply chain management, route optimization, and what impact they have on statistical decision-making. Subjects in the survey included the extent to which new technologies are used, difficulties in their implementation, and their impact on efficiency and decision accuracy for the supply chain. The results showed that companies implementing AI and Big Data are 35.25% more efficient than companies that do not, according to Listy et al. (2016). After data collection, it was processed and analyzed using descriptive statistical techniques to describe the nature of the data. Furthermore, regression analysis was conducted, as noted by Danendra et al. (2025) to explore the relationship between the use of AI and Big Data or other factors on operational management performance. Multiple regression analysis was applied to examine the direct and indirect effects of technology on production pressures in processes such as efficiency and decision-making quality.

Table 1. Aspects of AI and Big Data Usage

Analyzed Aspect	Description/Indicator	Data Collection Method	Measurement Scale	Testing Objective
AI Adoption Rate	Percentage of companies using AI in logistics operations	Questionnaire Survey	Likert Scale (1-5)	Measure the extent of AI technology adoption in logistics companies
Big Data Usage Rate	Use of Big Data for demand analysis, inventory management, and delivery routes	Questionnaire Survey	Likert Scale (1-5)	Assess the extent to which companies use Big Data in supply chain management
Operational Efficiency	Changes in delivery time, reduction in logistics costs, and improvement in productivity	Interviews and Survey	Ordinal Scale (high, medium, low)	Measure the impact of AI and Big Data usage on operational efficiency in the supply chain
Decision-Making Accuracy	Influence of AI and Big Data on decision-making related to inventory management and planning	Questionnaire Survey and Interviews	Likert Scale (1-5)	Analyze changes in decision-making accuracy in logistics after the implementation of these technologies
Implementation Challenges	Barriers faced in implementing AI and Big Data, such as cost and resource limitations	Questionnaire Survey	Likert Scale (1-5)	Identify the key challenges in adopting AI and Big Data technologies in the supply chain

The table above presents the aspects analyzed in the study regarding the implementation of AI and Big Data in the logistics supply chain. Each aspect is described with clear indicators, such as the adoption rate of AI, operational efficiency, and implementation challenges. The data collection methods used include surveys and interviews, with Likert or ordinal measurement scales. The main objective is to assess the impact of these technologies on operational decisions and to identify the challenges faced by companies during the implementation of these technologies.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. AI and Big Data Adoption Rate

This survey, involving 50 logistics companies, including large and medium-sized enterprises that have implemented AI and Big Data in their operations, showed that approximately 70% of the companies contacted for the survey have adopted AI in one way or another, with 30 percent still in the pilot or early implementation phase. Regarding Big Data, 60% of companies reported using the technology to its full potential, leaving only 40% still using traditional data management methods (Rolando et al., 2022). For example, AI is primarily used in inventory management systems, including demand forecasting. Therefore, Big Data can be used for more precise analysis of customer demand patterns or market trends, which can help plan inventory and deliveries to reflect actual situations. ANKEN research shows that companies using both technologies see significant improvements in inventory management and decision-making regarding the selection of shipping route options. Consequently, this approach has become standard practice for logistics companies across China, allowing them easy access to accurate information at all times.

Table 2. AI and Big Data Adoption

Technology	Companies Adopting (%)	Companies in Trial Phase (%)	Companies Not Adopting (%)
AI	70%	15%	15%
Big Data	60%	20%	20%

Table 2 shows the adoption rates of AI and Big Data among logistics companies. It reveals that 70% of companies have fully adopted AI, with 15% in the trial phase and 15% not adopting it. For Big Data, 60% of companies have fully implemented it, 20% are still in the trial phase, and 20% have not adopted it. This indicates a relatively higher adoption of AI compared to Big Data, suggesting different rates of technological integration within the industry.

3.1.2. Operational Efficiency and Decision-Making

One of the key findings of this study is how companies implementing AI and Big Data have seen significant improvements in operational efficiency. As stated in the report, 85% of companies using AI for demand forecasting have improved prediction accuracy by 20-30%. They can reduce inventory waste (sometimes called 'shelf obsolescence') by up to 25%, not to mention avoiding excess stock. This alone saves significant storage costs. At the same time, 75% of companies implementing AI for delivery route optimization saw a 15-20% reduction in delivery times, thereby reducing fuel costs and improving customer satisfaction (Gading Rayya Samita et al. 2024). AI also helps make faster, data-driven decisions, something that is crucial when dealing with rapidly changing demand dynamics. When applied to route management, one company's use of AI represented a 10% annual operational cost savings based solely on delivery route optimization. Meanwhile, 65% of companies using Big Data for inventory management reported operational cost reductions of up to 18%, simply because they were able to more directly predict demand trends and inventory needs. There are two important areas where AI and Big Data play a role in improving the quality of strategic decision making, namely 'which locations should we allocate to our suppliers, and how we organize them with supply lines and distribution planning. In relation to the data that has been obtained significant findings.

Figure 1. The Impact of AI and Big Data on Operational Efficiency

Figure 1 illustrates the impact of AI and Big Data on efficiency. These technologies improved planning accuracy by up to 25% and led to a corresponding reduction in demand forecasts. Delivery times were reduced by up to 20 minutes, further reducing customer wait times. Furthermore, operational costs decreased by 24%, resulting in overall greater profitability. All of these improvements also translate into increased throughput: logistics are optimized to produce higher yields. In this graph, we can see that AI and Big Data have a complementary effect on cost reduction. This results in improved decision-making; streamlined processes can increase productivity at every level of the supply chain.

3.1.3. Implementation Challenges

While AI and Big Data have proven to provide significant benefits, the companies involved in this study also identified various challenges in their implementation. Two of the biggest challenges are the high cost of implementing these technologies and the lack of staff with the appropriate skills to operate them. Seventy-two percent of companies surveyed stated that technology procurement, training, and infrastructure development significantly hindered their adoption of AI and Big Data. Integrating new technologies with existing systems was also a challenge for most companies. A 2024 survey by Sri Sulistyawati et al. found that most companies struggled with the complexity of integrating new technologies with their existing ones. In addition to these challenges, data security was also a major concern. 60% of companies surveyed reported having problems ensuring the security of their data used by AI and Big Data. Some companies also reported

stringent government privacy regulations, which made them more cautious about introducing these technologies.

Table 3. Challenges Faced in the Implementation of AI and Big Data

Challenge	Description	Percentage of Companies Facing the Challenge (%)
Implementation Costs	Acquisition of technology, training, and infrastructure required for AI and Big Data implementation.	72%
Limited Human Resources	Lack of skilled workforce to manage and optimize the use of AI and Big Data.	68%
Integration with Existing Systems	Difficulties in aligning new technology with existing operational systems.	55%
Data Security	Issues with protecting data used by AI and Big Data from potential breaches or attacks.	60%
Privacy Policies	Strict privacy policies, both from the government and internally within the company, hindering technology adoption.	50%

Table 3 outlines the challenges companies face when working with AI and Big Data. The biggest challenge is high implementation costs, with 72% of companies citing issues related to other technologies needed for various functions, technical operational expenses ranging from equipment purchases and installation of new facilities, as well as maintenance and management costs associated with setting up and preparing these new systems for operation. Furthermore, 68% of companies struggle with a lack of experienced human resources, while information protection in the workplace remains a widely acknowledged concern for 60% of companies. Integration with existing systems and strict privacy laws are also issues for companies, with 55% affected, while 50% are either complying with these standards or not. These challenges demonstrate how difficult it is for companies to introduce these technologies.

3.1.4. Improvement in Strategic Decision-Making

AI and Big Data can be used for data-driven decision-making, so these tools also impact strategic (i.e., overall) company decision-making (the overall goal is to create a carrier-focused/closed-loop platform). The use of AI and Big Data in decision-making also impacts strategic company actions, such as supplier management, distribution planning, contract negotiations, and more. 80% of companies implementing AI in supplier management report making better decisions when selecting suppliers and managing supplier relationships. With better data analysis tools, they can evaluate supplier performance and decide when to switch suppliers or negotiate tire prices (Arfah et al., 2025). As for distribution planning, 70% of operators using AI and Big Data in route analysis see a 15% reduction in delivery times. At least there's no need to mindlessly travel long distances on the highway now that we can get Eastern Airlines via Chicago! More integrated data means faster and more accurate decision-making about optimal distribution strategies.

Table 4. The Impact of AI and Big Data on Strategic Decision-Making

Strategic Decision	Impact of AI and Big Data Usage	Percentage of Companies Reporting Improved Decision-Making (%)
Supplier Selection	Enhanced ability to assess supplier performance and negotiate better prices.	80%
Distribution Planning	Reduction in delivery time and costs, along with improved customer satisfaction through more accurate route analysis.	70%
Contract Negotiation	Ability to negotiate more favorable contracts with suppliers and distribution partners.	65%
Supplier Performance Evaluation	More accurate assessment of supplier performance based on historical data and demand predictions.	75%

Table 4 shows the strategic impact of artificial intelligence (AI) and big data. The report concludes that AI and big data can significantly improve various decisions. For example, in supplier selection, 80% of participating companies demonstrated improvements in supplier performance assessments and negotiation outcomes. Seventy percent of these companies also significantly reduced delivery times and costs, while significantly improving customer satisfaction. Furthermore, 65 percent of companies believe AI and big data helped them negotiate contracts on more favorable terms. As another example, 75% of companies achieved more accurate supplier performance evaluations based on historical data combined with demand forecasts. These improvements demonstrate the value of these technologies in strategic decision-making.

3.1.5. System Integration Challenges

The study found significant challenges in system integration. Fifty-five percent of businesses surveyed experienced challenges integrating AI and Big Data systems into their existing systems. One reason is the disparity between legacy system architectures and the need to update existing infrastructure. Because the integration process is highly labor-intensive, it often requires significant time and money, making it a major barrier for many companies to fully adopt these new technologies. However, cost isn't the only challenge in implementing these technologies. Some companies also face challenges in acquiring raw data. Data spread across multiple departments or regions complicates data management and decision-making processes. Companies that successfully implement AI and Big Data typically establish clear policies for data management and maintenance, and have robust integration systems in place.

Figure 2. Challenges in AI and Big Data System Integration

Figure 2 highlights the key challenges in AI and Big Data system integration. The most significant issues are differences in system architecture (55%), the need to update infrastructure (60%), and limitations in accessing consistent data (50%). Additionally, 65% of companies face complexities in data management. These challenges emphasize the need for companies to address infrastructure gaps and ensure smooth data flow across systems to fully leverage AI and Big Data technologies in their operations.

3.2. Discussion

Logistics companies have begun to leverage technologies such as AI and Big Data. As many as 70% of companies use AI in various operations; while the other 60% rely entirely on Big Data. The most frequently seen applications of AI are in inventory control and demand forecasting. Big Data is used to analyze not only customer demand patterns but also, for example, market movements or underlying price trends. The application of these two technologies makes decision-making regarding destination delivery routes and inventory management much more accurate than before. This is very similar to the conclusions of Purbasari et al. (2023), who found that logistics digitalization, particularly the use of AI and Big Data, improves delivery accuracy and efficiency. Furthermore, research by Anam et al. (2025) shows that these technologies facilitate the integration of logistics systems, reducing reliance on slower and less efficient traditional methodologies.

Research has found that companies using AI for demand forecasting experience a 20-30% increase in forecast accuracy, which translates into a 25% reduction in remaining inventory. This prevents companies from carrying excess inventory and thus incurring higher carrying costs. These results are consistent with research by Lubis (2025), which shows that AI-based risk management in supply chain management can optimize inventory and improve efficiency. Optimizing delivery routes using AI also results in a 15-20% reduction in delivery times. Reduced fuel costs and increased customer satisfaction are significant business benefits. This echoes research by Eryc and Indasari Deu (2024), which states that the implementation of digital technology, including AI, increases accountability and makes operational decisions more efficient.

The biggest challenges in implementing AI and Big Data, according to the surveyed companies, are the high cost of technology procurement and the lack of personnel to manage or optimize it. Seventy-two percent

of companies cited the costs of implementation, training, and infrastructure procurement as key barriers. This is consistent with Soekirman's (2024) findings that it is crucial to engage in the provision of digital infrastructure and a skilled workforce to improve supply chain efficiency. Similarly, 60% of surveyed companies stated that difficulties in protecting data used by AI and Big Data pose significant risks. Meanwhile, Romadhona and Zulfairah (2024) emphasized the importance of data protection when advanced technologies are applied to supply chain management.

The use of AI and Big Data has been found to improve strategic decision-making quality in areas such as selecting suppliers or planning distribution. Long-term suppliers even gained 5% to 20% more as a result of technology. In total 80% of businesses show increased capability for selecting materials and printed prompt payment clauses in supplier agreements, thus helping their suppliers to work with customers who pay quickly. It also causes more rational decisions in product distribution and reduces manufacturing costs associated with moving goods around the country. Such findings confirm Hohenrath's (2025) study which found that AI and other Industry 4.0 technologies enable companies to make decisions which are both more responsive to rapidly changing world markets. However, this is not without its problems: 55% of organizations encountered difficulty integrating AI and Big Data systems with existing systems. This is because legacy system architectures differ from the manner in which modern applications need to be accommodated. This task is also consistent with the challenges frequently faced during digital transformation. This is, as Laurenz (2025) notes, integrating new technology into old systems requires huge capital investment for infrastructure upgrades and several years of smooth transition.

3. CONCLUSION

This research shows that the application of Artificial Intelligence (AI) and Big Data has a profound impact on decision-making efficiency and operational efficiency in the logistics domain. A 30% higher demand forecast accuracy (thanks to AI) also means a 25% reduction in inventory waste on average. With AI-based route optimization, delivery times can be reduced by 15-20%7-11. Companies can now apply Big Data to gain a more accurate picture of actual demand patterns and market trends. Combining this with Big Data enables greater efficiency in inventory planning and distribution. Companies using Big Data, according to a survey, have seen 18% lower operational costs, primarily due to the improved predictability of inventory needs inherently linked to Big Data. While technology has many advantages, it is inevitable that barriers will arise; to progress to a certain extent in improving logistics operational efficiency and resilience, he reiterated. The significant costs associated with technology acquisition, training, and infrastructure have been the main barriers to companies leveraging AI and Big Data, according to a survey of 72 companies. For companies, those who miss their legacy records find integration with existing systems a common issue that slows down turnaround. Then there's the issue of data security. Companies struggle to maintain data security across both types of technology, with over 60% of respondents citing data security as a very important issue. While there may be barriers preventing these integrations, AI and Big Data have proven effective in improving operational efficiency and resilience for supply chain management. To fully leverage the technologies available today, companies must improve their organizational readiness and focus on better training and system integration.

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