

AI, Big Data and Supply Chain – A revolution in Progress

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Abstract : This article explores the integration of artificial intelligence (AI) and big data in supply chain management through the case study of NOZ France. It highlights the operational benefits, technical challenges, and strategic implications of this digital transformation. The analysis shows that these technologies enable optimized decisionmaking, better demand forecasting, and efficient inventory management.

Keywords : Artificial Intelligence, Big Data, Supply Chain, Digital Transformation, NOZ France.

I. INTRODUCTION

Globalization and digitalization have deeply remodeled the chains supply modern, making them both more interconnected and more vulnerable to disruption. In this context changing, companies are faced with increasing challenges in terms of competitiveness, speed, personalization and above all traceability of flows. The evolution rapid rise in consumer expectations, increased regulatory pressure on sustainability, as well as unforeseen disruptions such as health or geopolitical crises, require a reinventio n complete models traditional Supply Chain Management (SCM) methods.1. The evolution of the Supply Chain in the digital age Faced with this complexity, intelligence Artificial Intelligence (AI) and Emerging Big Data as technological levers majors, capable of transforming into depth of chain management logic logistics. In effect, AI allow to automate and optimize processes complex decision -making , while Big Data offers the ability to exploit massive volumes of data heterogeneous in real time. Integration The combination of these technologies not only allows to improve visibility and responsiveness throughout the chain, but Also to anticipate risks, strengthen resilience, and responsiveness throughout the chain, but also to anticipate risks, strengthen resilience, and generate a sustainable competitive advantage.

This technological revolution is not limited to an incremental improvement in performance; it constitutes a rupture in the way in which physical, informational and financial flows are managed. Through the analysis of a practical case —that of the French company NOZ —this article explores how AI and Big Data can be mobilized to establish intelligent traceability, improve synchronization logistics, and meet the growing demands for customization and sustainability . This work is part of a broader reflection on the future of Supply Chains in the digital age, where agility and intelligence become the news performance standards.

II. THE EVOLUTION OF THE SUPPLY CHAIN IN THE DIGITAL AGE

Historically, the chains supply were designed on models linear, process - based manuals and systems rigid. Each step of the chain was often isolated, with limited communication between the different actors. circulating often in an out -of-sync manner, resulting in delays in product delivery, stockouts, and wasted resources.

With the advent of digital technology, the supply chain has suffered a profound transformation. Emerging technologies such as the Internet of Things (IoT), supply chain management systems supply in real time, intelligence artificial intelligence (AI), and big data have changed the way businesses design and manage their chains supply. This digital transformation allows businesses to adopt much more flexible, responsive processes adapted to market fluctuations.

The integration of digital technologies into processes logistics allowed more efficient inventory management, a reduction of delivery times, and a improvement of operational performance. For example, the use of systems Automated inventory management and demand forecasting helps businesses anticipate market fluctuations and adjust their production or their supplies in real time. The algorithms of intelligence artificial are now able to predict consumer trends with a much greater precision, reducing thus errors and waste related to bad forecasts. Digitalization favors also a better collaboration between the different actors of the chain supply, including suppliers, distributors and partners logistics. Collaborative platforms allow these different actors to share information in real time, ensuring Thus a better coordination of operations. Blockchain and other traceability technologies make it possible to trace every stage of a product's journey, from its production to its final delivery. This reduces risks of errors human, fraud, and allows a better management of product returns.

Another key aspect of digital transformation in the supply chain is product traceability. Systems digital offer the possibility of tracking products throughout their life cycle, from their production up to their final delivery. This is particularly important in sectors as food, automotive, or pharmaceutical industries, where safety and compliance are issues majors. For example, technologies like blockchain ensure complete transparency and verifiability of information, reinforcing thus the confidence of consumers and regulators.

III. THE CENTRAL ROLE OF ARTIFICIAL INTELLIGENCE

Intelligence artificial intelligence (AI) transforms deeply channel management supply in enabling businesses to analyze massive and complex volumes of data to extract information crucial that help in decision making strategic. One of the advantages major AI players in this context is his ability to anticipate events future and to optimize processes operational in real time. One area where AI is having a significant impact is demand forecasting. Historically, companies relied on statistical methods and limited historical data to predict product demand. However, these approaches were often inaccurate and did not take into account complex variables such as market trends, consumer behavior, or external factors (economy, weather, etc.). Thanks to machine learning algorithms, AI can now analyze much larger and more diverse data sets. It uses techniques such as neural networks, supervised and unsupervised learning, and predictive models to identify hidden patterns in the data. This allows businesses to more accurately forecast short- and long-term demand, reducing the risk of stockouts or excess inventory.

AI also plays a key role in transport planning and logistics route management. Companies face complex challenges related to route management, vehicle capacity, costs, and delivery times. Traditional transport management systems were often rigid and based on fixed rules, which did not offer much flexibility in the face of unforeseen events (traffic conditions, breakdowns, emergencies, etc.).

AI solutions, on the other hand, can analyze a multitude of factors (traffic, weather, vehicle availability) in real time to determine the optimal route. Route optimization algorithms, such as those based on genetic algorithms or ant colony

optimization, can offer solutions that are not only faster but also more economical, reducing operational costs related to transportation and improving customer satisfaction through more on-time deliveries. AI is also being used for anomaly detection, a crucial area in supply management. chain. Businesse face risks related to human error, fraud, production defects, or unforeseen events that can disrupt the supply chain. AI systems can continuously monitor supply chain processes and identify abnormal or suspicious behavior by comparing real-time data with pre-established behavior patterns.

For example, AI can detect discrepancies in inventory levels, errors in orders, or delays in delivery times, allowing logistics managers to take corrective action quickly. This proactive anomaly detection minimizes the risk of disruption and allows for action before a major problem arises.

AI, by integrating machine learning algorithms, also makes it possible to automate many decisions within the supply chain. chain. For example, AI systems can automatically decide whether to replenish inventory, adjust production levels, or even choose the most suitable supplier based on cost, time, and quality criteria. These capabilities enable businesses to respond more quickly to changes and make decisions in real time, without having to wait for human intervention. Automating these processes not only improves supply responsiveness chain but also frees up time so that managers can focus on higher valueadded tasks, such as strategy or innovation.

IV. BIG DATA, FUEL FOR INTELLIGENCE IN THE SUPPLY CHAIN

In context current supply chain, companies generate daily a massive amount of data from various internal and external sources. These data include, for example, information relating to stocks, orders, sales forecasts, information weather, traffic conditions, as well than to the performance of suppliers. However, although these data be rich in information potential, their volume and their diversity represent a challenge major for businesses. It is here that Big Data and Intelligence Artificial (AI) enter into play, transforming these data into a strategic lever to improve supply chain performance.

Big Data refers to the ability to collect, store and analyze huge data sets at a speed and at a scale than the systems traditional systems cannot manage. In the supply chain field, Big Data makes it possible to centralize and structure information from internal and external sources, creating Thus a solid basis for decision - making

Companies can From now on centralize data such that:

The information internal: stocks, orders, production levels, equipment performance, etc.

The information external: weather conditions, traffic in real time, consumer behavior, supplier flows, etc.

In combining these data Big Data allows companies to better understand trends, predict risks and improve visibility across the entire chain supply. One of the biggest benefits of Big Data for procurement The key to improving supply chain visibility and responsiveness is to centralize and analyze all this data in real time. Companies can gain a much more accurate overview of their supply chain. This allows them to track inventory levels, monitor delivery times, and detect potential anomalies or risks, whether they arise from suppliers, transportation conditions, or production. Responsiveness is also greatly improved. For example, if an unforeseen event occurs (a supplier delay, a weather alert, or a warehouse stockout), companies can immediately adjust their plans based on the new information. With real -time data analysis, companies can quickly respond and minimize the impact of these disruptions, ensuring continuity of supply.

The true potential of Big Data is unfolded when combined with artificial intelligence (AI). While Big Data collects and centralizes data, AI uses machine learning and deep learning algorithms. learning to analyze this data and extract strategic insights. Here's how AI, in combination with Big Data, can become a real performance lever for supply chain:

Accurate Demand Forecasting : AI can analyze historical and current market data to more accurately predict future demand, even when factoring in external factors like seasonal trends, promotions, or socioeconomic events.

Inventory and order optimization: Using AI algorithms, businesses can predict future inventory needs and optimally manage their orders, reducing the risk of overstocking or stockouts.

Logistics Route Planning: AI, using traffic, weather, and transportation capacity data, can optimize delivery routes, reducing transportation costs while ensuring on-time deliveries.



Proactive risk management: AI can identify potential risks within the supply chain by analyzing patterns in data. For example, if a supplier has a history of delays or if adverse weather conditions are forecast in a transit area, AI can alert supply managers. chain, allowing them to take preventive measures.

Improved supplier collaboration : By analyzing supplier data, AI can also help companies assess the performance of their partners. This helps identify the most reliable suppliers and make decisions based on objective data rather than hunches or historical relationships.

V. APPLICATION CASE : TRACEABILITY SMART AT NOZ France

NOZ, a business specialized in the resale of products unsold, for a long time encountered difficulties linked to the visibility of its logistics flows. Due to the diversity of its products and its suppliers, product traceability throughout the chain supply was complex. The information were scattered and difficult accessible, which created inefficiencies and errors in order processing.

a. The challenge of visibility and traceability

Because of its model business product - oriented unsold, NOZ was faced with challenges unique. The products came from various sources, with different characteristics and expiration dates varied, making their management even more complex. In addition, the diversity of suppliers and distribution channels complicated further inventory tracking and logistics flow management.

Without a visibility clear and in real time on these flows, NOZ faced several problems :

- Mistakes frequent in order processing
- Delays in deliveries
- Non optimized stock levels

b. The solution based on AI and Big Data

To solve these problems, NOZ decided to put put in place an Intelligence - based solution Artificial

Intelligence (AI) and Big Data, allowing thus to centralize and analyze in real time all data logistics. This solution was designed to automate the collection of information coming from the different actors of the chain supply, that it whether internal data (stocks, orders, stock levels) or external data (suppliers, transport conditions, information in real time).

Automation of data collection: AI has enabled to automate the data collection process, reducing so the errors hum an resources and information update times. IoT (Internet of Things) sensors have been installed to track products at every stage of their route, from the supplier until NOZ store. These sensors transmit information in real time, allowing the company to have a complete and precise vision of the entire chain logistics. *sticking points* : The integration of AI has also permit to identify quickly identify blocking points in logistics flows. The algorithm of AI analyzes the data historical and real- time to detect anomalies, delays or inefficiencies in the process. For example, if a delivery is delayed or if a supplier does not meet

its deadlines, the system can alert automatically supply chain managers for that they can take immediate corrective action. *Reliable product tracking*: The Big Data – based solution has strengthened product traceability throughout the chain supply. Each product is now digitally tracked, from its arrival in warehouses to its distribution in NOZ stores. This not only allows to guarantee a better inventory management, but also to provide accurate and reliable information on the status of products at any time.

c. The results obtained:

The implementation of this digital solution has enabled NOZ to make improvements significant in its logistics management:

Reduction of processing errors: Thanks to the automation of data collection and the centralization of information, NOZ was able to eliminate a large part of the errors human, reducing as well as errors in order and stock processing.

Improving operational performance : Optimization of logistics flows and proactive detection of problems have permit to improve considerably operational efficiency. Field teams are now in able to manage products and orders more smoothly and responsively

Save time for teams field : The teams no longer have to devote as much time to enter manual data or error management. They can focus on higher value tasks added, such as managing supplier relationships or improving customer satisfaction.

VI. LIMITATIONS AND CHALLENGES

The integration of intelligence Artificial Intelligence (AI) and Big Data in supply chain management have advantages considerable, but She is not without challenges. Businesses must take into account account several obstacles related to financial investment, cybersecurity, data governance, as well than resistance to change. Furthermore, it is crucial to emphasize that AI should not be view as a replacement for employees humans, but instead like a tool that comes complement and improve capabilities human.

a. The cost of integrating technologies

One of the main obstacles to the adoption of AI and Big Data in chains supply is the high initial cost. This cost understand several aspects:

Investment in hardware and infrastructure: Companies must invest in technological infrastructure adapted, such as servers powerful, cloud platforms, IoT (Internet of Things) sensors, and software specialized in data management. These investments can be important, especially for medium or small sized businesses.

Team training : The introduction of new technologies requires also ongoing training for employees. The teams logistics, IT managers, and managers must be trained in the use of new AI and Big Data solutions. This training process can It can be time-consuming and costly, but it is essential to ensure successful adoption of technologies.

Consultation and implementation work: Many companies choose to use external consultants or companies specialized to support them in the integration of these technologies. The costs

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associated with consultation, customization of solutions and support during implementation artwork can quickly to accumulate.

b. Cybersecurity and data governance

Once the technologies are in place, companies must also take into account takes into account cybersecurity and data governance issues :

Cybersecurity: With the increase in data collected and shared in the supply chain, data protection sensitive becomes a priority. Companies must put put in place security systems robust to protect themselves against cyberattacks, including hacks, ransomware or data leaks. Secure data management from multiple sources (internal, external, suppliers, etc.) is a constant challenge

Data Governance: Data quality management and data governance are crucial aspects to ensure that information used by AI and Big Data are accurate and reliable. Companies must establish strict policies in terms of data management, their cleaning, and their regular updating. Poor data management can lead to errors in forecasts, a bad inventory optimization and process disruptions logistics

c. Resistance to change

The transition to a digitalized supply chain is accompanied often resistance to change within teams. Certain rea sons explain this reluctance :

Fear of loss of control : Employees can fear of losing their job or to see their responsibilities decrease due to process automation. This can generate resistance to the adoption of new technologies, even if these The latter are intended to improve the efficiency of operations and to lighten some tasks repetitive Work habits : Workers can being accustomed to traditional and proven working methods, and the introduction of disruptive technologies can disturb their daily routines. The change in organizational culture necessary to accept these technologies may be difficult to manage.

Lack of understanding of the benefits : If the benefits of AI and Big Data are not clearly communicated to employees, these last may not see the value added value of these technologies. Effective communication and well- conducted change management are crucial to overcome these barriers.

d. AI: Complement to the human, not a replacement

One of the misunderstandings frequent around the introduction of AI in businesses is the perception according to

which She would replace employees humans. But, above all else, AI is a tool meant to augment and support human abilities, not take their place.

Decision making optimized: AI can process and analyze massive volumes of data far faster than humans, but decisions strategic must always rely on expertise human. Those responsible logistics and managers must interpret the recommendations provided by the systems of AI and adapt them to the context of their business.

Benefits of AI and Big Data. A governance adapted is therefore necessary to ensure that these technologies are used ethically and that they benefit both the company and its employees.

VII. CONCLUSION

AI and Big Data are not just transformational technologies, but pillars strategic for the supply chain of tomorrow. Companies that will be able to adopt them in a thoughtful and responsible manner will be better prepared to face challenges futures. However, for this transformation to be sustainable, it must be done in a progressive, ethical manner, and in putting people at the center of the process.

Value creation: In automating some tasks repetitive and in providing accurate analytics, AI frees up time for employees, their allowing to focus on higher value activities added, such as supplier relationship management, innovation, or continuous process improvement.

Human- machine cooperation: Collaboration between humans and machines is essential to achieve take full advantage

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