

Sustainable Outcomes of Automation in Logistics Operation

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ABSTRACT: Automation is revolutionizing industries worldwide, and logistics and supply chain management, pivotal sectors in global commerce, are no exception. In the logistics industry, automation refers to the software tools and technologies that help in streamlining operations, enhancing efficiency, optimizing resources, and reducing costs. From automated warehouses utilizing robotics for inventory management to AI-powered predictive analytics optimizing route planning, automation is reshaping the logistics industry. Its implementation is crucial for meeting growing consumer demands, improving delivery speeds, and staying competitive in an increasingly digital marketplace. For logistics companies, utilizing automation promises not only operational excellence but also the ability to adapt and thrive in a dynamic business environment.

KEYWORDS-sustainable, automation, logistics, operation, outcomes

I.INTRODUCTION

Logistics automation refers to the application of automated systems, technologies, and processes to streamline and optimize various functions within the logistics and supply chain management. This involves the use of advanced technologies such as robotic process automation (RPA), artificial intelligence (AI) and machine learning, and other software solutions to automate tasks traditionally performed by humans. It helps to achieve a seamless, agile, and responsive logistics ecosystem in the face of evolving market demands. The logistics industry is expected to grow significantly in the next few years, and automation offers a pathway to achieving greater efficiency, scalability, and agility. Automation enhances responsiveness to market demands, enabling businesses to adapt quickly and capitalize on emerging opportunities in the dynamic logistics landscape.

Automation has become an essential aspect of logistics operations, enabling companies to improve efficiency, reduce costs, and enhance customer satisfaction. With the use of automated systems, logistics companies can handle a vast amount of data, optimize routing, and streamline processes, resulting in faster delivery times and reduced errors.

Automation is transforming the logistics and supply chain industry by improving efficiency, reducing costs, and increasing accuracy. Here are some of the technologies driving automation in logistics and supply chain management:[1,2,3]

Robotic Process Automation (RPA)

RPA involves deploying software robots to automate repetitive, rule-based tasks such as data entry and order processing, reducing manual labor, improving accuracy, and accelerating logistics processes.

Artificial Intelligence (AI) and Machine Learning (ML)

AI and ML algorithms analyze large datasets to enhance decision-making in logistics. They optimize route planning, predict demand, and streamline operations by learning and adapting to changing patterns and variables.

Warehouse Management Systems (WMS)

Warehouse Management Systems (WMS) are being used to automate tasks such as inventory management, order processing, and shipping. By using WMS, logistics companies are able to track goods throughout the warehouse and optimize their operations.

Transportation Management Systems (TMS)

Transportation Management Systems play a pivotal role in the automation of logistics processes. TMS software leverages automation to streamline freight planning, execution, and monitoring, optimizing transportation routes and reducing costs. By automating tasks such as carrier selection, load tendering, and freight auditing, TMS enables greater efficiency and accuracy in logistics operations.

Cloud Services:

Cloud-based platforms provide a scalable and centralized infrastructure for logistics operations. They enable real-time data sharing, collaboration, and accessibility, allowing for seamless communication and efficient management of resources across the supply chain.

Data Analytics[2,3,4]

Data analytics involves extracting meaningful insights from vast amounts of logistics data. By analyzing trends, patterns, and performance metrics, logistics providers can make data-driven decisions, optimize processes, and improve overall operational efficiency.

Internet of Things (IoT)

The Internet of Things (IoT) is helping logistics companies to track goods throughout the supply chain in real-time. By using sensors and other connected devices, logistics companies are able to monitor the location, temperature, and condition of goods as they move through the supply chain. This allows logistics companies to optimize their operations and provide better services to their customers.

Benefits of Automation in Logistics and Supply Chain Management

Logistics automation has become increasingly popular in recent years due to its ability to streamline operations and increase efficiency. By incorporating automation technology into logistics processes, companies can achieve several benefits that can help them stay competitive in today's fast-paced business environment

Increased Efficiency and Productivity

One of the most significant benefits of automation in logistics is increased efficiency and productivity. Automated systems can perform tasks faster and more accurately than humans, which can help reduce the time required to complete tasks and increase productivity. For example, automated conveyor systems can transport goods from one location to another much faster than manual labor, allowing companies to move more products in less time.

Enhanced Accuracy and Reduced Errors

Automation can also help reduce errors and improve accuracy in logistics processes. Automated systems are designed to perform tasks with a high degree of precision, reducing the risk of errors that can occur when tasks are performed manually. For example, automated inventory management systems can track inventory levels in real-time, reducing the risk of stockouts or overstocking.

Cost Savings

Another benefit of automation in logistics is cost savings. Automated systems can help reduce labor costs by performing tasks that would otherwise require manual labor. Additionally, automation can help reduce the risk of costly errors, such as shipping the wrong product or overstocking inventory. By reducing these costs, companies can improve their bottom line and stay competitive in the market.[3,4,5]

Improved Customer Satisfaction

Automation can help improve customer satisfaction by reducing lead times and improving order accuracy. Automated systems help to deliver products on time and in the correct quantities, reducing the risk of customer complaints. Additionally, automation can help companies provide better customer service by providing real-time updates on order status and inventory levels.

Strategies for Implementing Automation in Logistics and SCM

Assessment and Planning

Before implementing automation in logistics, it is essential to conduct a thorough assessment of the current processes and identify areas that can benefit from automation. This assessment should include an analysis of the existing infrastructure, processes, and process capabilities. Once the assessment is complete, a detailed plan should be developed that outlines the implementation strategy, timeline, and expected outcomes.

Technology Integration

Integrate automation technologies such as RPA, AI, ML, and IoT seamlessly into existing systems to enhance efficiency and accuracy.

Pilot Programs

These programs involve testing automation technologies on a small scale before deploying them across the entire logistics network. This approach allows organizations to identify potential issues and make necessary adjustments before investing in full-scale deployment. Pilot programs can also help build support and buy-in from stakeholders.

Gradual Implementation

Roll out automation in phases to minimize disruptions, allowing for proper testing and optimization at each stage.

Collaboration with Technology Providers

Partner with technology vendors and specialists to ensure the selection of the right tools and technologies tailored to specific logistics and SCM needs.

Full-Scale Deployment

Once the assessment and pilot programs are complete, organizations can move forward with full-scale deployment of automation technologies. This involves implementing automation solutions across the entire logistics network. To ensure a successful deployment, it is essential to have a well-trained employees, ongoing support and maintenance, and a plan for continuous improvement.

Real-time Monitoring and Analytics

Implement monitoring systems to track the performance of automated processes in real-time, using analytics to identify areas for continuous improvement.

Scalability Considerations

Choose automation solutions that are scalable to accommodate future growth and changes in logistics demands.

Cybersecurity Measures

Prioritize cybersecurity to protect sensitive data and ensure the integrity and reliability of automated systems.[4,5,6]

II.DISCUSSION

Major Challenges for Deploying Automation in Logistics

Automation has the potential to revolutionize the logistics industry by increasing efficiency, reducing costs, and improving the overall customer experience. However, deploying automation in logistics is not without its challenges. This section will outline some of the major challenges that companies face when implementing automation in logistics.

Integration with Existing Systems

One of the biggest challenges of deploying automation in logistics is integrating new systems with existing ones. Many logistics companies USE customized systems that they have developed over years of operation. Integrating new technology with these systems can be a daunting task and requires careful planning and execution. Failure to integrate new systems properly can result in disruptions to operations and loss of revenue.

Staff Training and Labor Concerns

Another challenge of deploying automation in logistics is the need to train staff to use new systems. This can be a time-consuming process and requires significant investment in staff training and development. Additionally, there may be concerns about the impact of automation on jobs in the logistics industry. Companies need to be transparent with their staff about the changes that automation will bring and provide support to those who may be affected by these changes.

Cybersecurity and Data Privacy

Automation in logistics requires the use of data and technology, which can make companies vulnerable to cyber attacks and data breaches. Companies need to ensure that their systems are secure and that they have robust security measures in place. They also need to comply with data privacy regulations to protect the personal information of their customers.

Regulatory Compliance[5,6,7]

Deploying automation in logistics requires compliance with a variety of regulations and standards. This includes regulations related to safety, environmental protection, and labor practices. Companies need to ensure that their automation systems comply with these regulations and that they have the necessary permits and certifications to operate.

Future Trends to Look Out for in Logistics Automation

As technology continues to advance, logistics automation is expected to become even more prevalent in the industry. Here are some future trends to keep an eye on:

Increased Integration of Artificial Intelligence (AI)

AI in logistics automation will help optimize routes, predict demand, and improve inventory management. In the future, AI is expected to become even more integrated into logistics operations, with the ability to make real-time decisions and automate more complex tasks.

III.RESULTS

Expansion of Autonomous Vehicles

Autonomous vehicles are already being used in logistics, particularly in last-mile delivery. More autonomous vehicles being used for long-haul transportation, reducing the need for human drivers and increasing efficiency.

Greater Use of Robotics

Robotics technology is already being used in warehouses to automate tasks such as picking and packing. In the future, we can expect to see even more advanced robotics technology being used, such as drones for inventory management and robotic arms for loading and unloading.

Increased Emphasis on Sustainability[6,7,8]

As concerns about climate change continue to grow, logistics companies are placing a greater emphasis on sustainability. Logistics automation can help reduce emissions by optimizing routes and reducing the need for human drivers. We can expect to see even more sustainable practices being implemented, such as the use of electric and hybrid vehicles in the coming years.

Augmented Reality (AR) and Virtual Reality (VR)

Enhances visualization and training processes. AR overlays real-time information onto physical environments, aiding workers in tasks like order picking. VR creates immersive simulations for training, enabling hands-on experience in a virtual setting. Both technologies improve accuracy, reduce errors, and enhance overall operational efficiency in areas such as inventory management and warehouse operations.

Freight activity is growing multifold with each passing day. Mobile adaptivity, convenience, and omnichannel retailing are critical factors that have accelerated the growth of e-commerce. This has spurred a surge in online orders, resulting in increased deliveries and miles traveled globally.

The global freight forwarding market is expected to be more than USD 206 BN by 2025. However, the face of global consumerism is changing in light of environmental challenges as consumers, investors, and supply chain professionals are all focusing on sustainable supply chains.

CDP's Global Supply Chain Report 2015 estimated that within the next five years, companies would face up to US\$120 billion in costs from environmental risks in their supply chain. In a rapidly changing market, this has become all the more necessary to remain resilient and competitive.

In this blog, we will discuss how sustainable supply chain approaches enable enterprises to meet rising customer expectations in an economical and environmentally-conscious manner.

Sustainable Supply Chain: An Overview[7,8,9]

Sustainability in the supply chain includes incorporating ethical and environmentally conscious practices and processes in the business operations to reduce carbon footprint. The goal is to increase business efficiency for greater ROI without negatively affecting the environment.

A sustainable supply chain is about gaining a holistic view of the entire supply chain operations, from product storage, resource optimization, and responsible outsourcing of the produced items.

It begins with the mapping of the entire supply chain ecosystem, and the supply chain managers must identify both the risks and opportunities that come with it.

Even though consumer demands keep increasing, buyers are becoming conscious of their shopping habits and environmental repercussions.

The Global Sustainability Study revealed that 85% of people feel that their purchase behavior has shifted towards being more sustainable in the last five years. And more than one-third of customers are willing to pay more for sustainable products or services.

In recent times, there has also been a significant shift in the sustainability mindset from 'good to have' to 'must have' for all enterprises. A major contributor to the economy, logistics transportation is responsible for 37% of CO2 emissions from end-user sectors. So, it is imperative to adopt operational and technical energy efficiency measures to drive sustainability in supply chains.

In the next section, we will now explore the three major components of a sustainable supply chain.

Three Pillars of Supply Chain Sustainability

People, processes, and business – these are the three pillars of sustainable supply chains. So, ideally, businesses should be able to deliver delightful customer experiences via highly optimized and sustainable processes (operations) without harming the business deliverables or revenue.

However, due to the massively disparate nature of supply chains, highly volatile logistical movements, and rapid disruptions, they often grapple with realizing their sustainability goals.

Now, technology and automation might emerge as general answers to overcome this challenge, but it is the right implementation, quality, and extent of integration and data-driven learning from previous experiences that play the major role.

Some of the ways supply chain professionals and leaders are implementing the above-mentioned practices to build sustainable supply chains are as follows:

- Smart automation for real-time route planning & optimization, vehicle capacity utilization, and maximizing deliveries per vehicle to reduce carbon emissions during transportation.
- Reverse logistics optimization by reducing the distance traveled for the RTOs. This can be made possible by making the goods available 'for sale' and storing them at the destination warehouse for the next order.
- Intelligent order allocation for order clubbing and multi-drop pickup based on route and location. This allows a single rider to accomplish multiple tasks in real time without affecting the SLAs. The consequent reduction in transportation and resulting carbon emission is of great economic and environmental value.[8,9,10]
- Predictive analysis to understand the pattern of empty miles after delivery fulfillment. This is then resolved by intelligent order allocation and capacity utilization of vehicles.
- Efficient fleet management by automating the order and driver allocation process. Enterprises can select the best possible option by considering multiple factors like current workload, delivery location, vehicle type, order volume, etc.

Next, we discuss how the right automation and right implementation that gets improved over time can help build a sustainable supply chain.

Building a Sustainable Supply Chain: How to Make the Most of Automation

Stats suggest that 62% of the organizations have modeled as much as 25% of their businesses, still, only a meager 2% have modeled all their processes. Further, 94% of organizations prefer working with a unified automation platform instead of multiple disparate tools, and yet, only 38% of them have taken the first step towards automation.

Hence, it is not surprising that when the supply chain management market is growing at a CAGR of 10.7% and is expected to be USD 52,632.37 MN by 2030, only 6% of companies have full visibility over their supply chains.

Implementing automation such that it offers a unified view of the entire supply chain and logistics ecosystem and helps businesses manage, track, control, and monitor all the processes and operations from a single dashboard is crucial for introducing sustainability in supply chains.

Such unified platforms also enable the supply chain managers to communicate and collaborate with all the stakeholders in real time and track individual performance via smart KPI management. They can check the real-time status of every shipment, every on-the-move order, vehicle, and even the reasons for returns or delivery failures.

We discuss more of these capabilities in detail in the next section.

Key Automation Elements That Drive Supply Chain Sustainability

Intelligent Functionalities

As companies move away from traditional logistics management practices and adopt newer alternatives, the productivity of delivery operations also increases. With intelligent functionalities, such as shipment/order tracking, real-time status tracking, automated alerts and notifications, and information standardization, companies gain end-to-end visibility of each product within the supply chain.

The smart AI/ML routines help them access highly advanced functionalities, such as Geocoding feature for easier location identification, smart order clubbing, a multi-drop pickup feature, etc.

These features help optimize delivery trip KPIs, such as distance traveled, route length, load carried, etc. In this way, brands can make their supply chains sustainable in both an economic and environmental sense.

The demand for faster delivery or same-day delivery of goods and services is stretching resources and increasing the complexity of supply chain operations. In addition, commercial vehicles are contributing to the already rising carbon emissions.

AI-driven decision-making and automation along with the use of cleaner energy sources can drive sustainability in transportation, while balancing costs and improving profitability. Real-time information and responsive algorithms are better at responding to dynamic demand scenarios. Automation in logistics helps optimize vehicle trips, labor usage, inventory levels, warehousing, and supplier management. This will in turn, reduce wastage, drive efficiencies and support sustainability in logistics. In the long run, businesses can increase revenue at lower operating costs, enhance customer service and achieve their sustainability goals.

Towards a sustainable supply chain enterprise

With the rapid increase in e-commerce, improving efficiencies of logistics and transportation operations has become a major concern for enterprises. The increased complexity of operations (including same-day delivery) has stretched resources such as material Opens in new tab and labor beyond capacity. Enterprises are looking for sustainable solutions to not only ease operations but also improve profitability in the long run.[9,10]

Advanced technologies such as artificial intelligence (AI) and automation, can help enterprises optimize the use of resources while streamlining supply chain operations. This white paper accentuates the potential of improved efficiency in decision-making for reducing resource consumption of logistics and transportation in enterprises. Combined with

human-in-the-loop automation and cleaner energy sources, the enterprise of the future can lead sustainability transformation.

Reasons to adopt sustainable measure

E-commerce and faster delivery services have grown like never in the last five years. The COVID-19 pandemic further accelerated the trend. With more than half the global population living in cities due to rapid urbanization Opens in new tab, these trends lead to extreme congestion and increased carbon emissions. Transportation activities constitute more than 60% of the world's oil consumption Opens in new tab, with road transport accounting for 70% of that amount Opens in new tab. Commercial vehicles are essential for fast e-commerce deliveries, and these are responsible for a disproportionately larger fraction of carbon and noxious gas emissions compared to their contribution to overall vehicles journeys.

Consequently, these factors slow down and hamper our progress in reducing global greenhouse gas emissions by 7.6% each year Opens in new tab until 2030. Enterprises need a balanced approach that enhances the customer shopping experience while optimizing costs of logistics and transportation and leading to overall reduction in carbon emissions.

The growing need for advanced technologies

The overall process of managing the supply chain and transportation consists of multiple computationally challenging stages including loading of parcels into containers or trucks, crew scheduling, sorting, and packaging goods for intended destinations, managing inventory, and optimal routing of delivery vehicles. The interconnected nature of these stages makes the problem of balancing costs with sustainability increasingly complex.

Consider the schematic diagram of an enterprise supply chain as shown below. Like most complex systems-of-systems, a decision taken anywhere in the supply chain has a cascading effect throughout. For example, a small reduction in inventory of one product leads to lower availability in stores and higher demand in regional warehouses to replenish the shortage. We believe a combination of AI-driven decision-making, automation, and the use of cleaner energy resources will help businesses achieve the dual objective of efficiency and sustainability.[10]

A graphic representing logistics and transportation functions in an enterprise supply chain.

An overview of logistics and transportation functions in an enterprise supply chain.

View description

The introduction of electric vehicles (EVs) has added a whole new dimension to sustainable deliveries. These EVs offer certain distinct advantages such as reduced carbon emissions, subsidies and incentives from governments, and access to parts of cities (especially in European countries) that are otherwise inaccessible for traditional delivery vehicles.

AI for sustainable logistics and transportation

Given the complexity of the operations involved in supply chains, enterprises must go beyond deploying EVs and using eco-friendly packaging material to ensure sustainability. Though these new technologies reduce the impact of transportation and logistics on the environment, they are not sufficient to achieve ambitious sustainability goals. A more consummate revolution is taking place in algorithms that manage these functions, and this can lead to leaner and efficient enterprises.

Real-time information and responsive algorithms enable enterprises to adjust to changing requirements. Simultaneously, enterprises must work with flexible vendors and put in place more aggressive inventory policies to ensure efficient utilization of labor and transport resources.

A graphic below depicts the enterprise of today. Despite the dynamic nature of customer demand, real-time information does not resonate throughout the supply chain; it is generally siloed in the last mile portion. This leads to less efficient operations and in extreme cases, can cause severe disruptions because of a mismatch between expectations and reality.

A representation of logistics and transportation system within an enterprise's supply chain.

A schematic view of the present-day logistics and transportation system within an enterprise's supply chain.

View description

Assuming the physical entities in the supply chain remain constant, the graphic below shows the use of algorithms to improve the responsiveness of the enterprise.

An ideal logistics and transportation system in an enterprise supply chain, resulting in efficient and sustainable operations.

An ideal logistics and transportation system is represented where changes are effectively communicated throughout the enterprise supply chain, leading to efficient and sustainable operations.

View description

The two examples below show the potential impact of such AI-driven algorithms on the enterprise:

Optimized transport routes: In e-commerce doorstep delivery, reducing the number of vehicles in operation saves fuel and manpower costs with the added benefit of lower carbon emissions. Identifying opportunities for combining routes for multiple vehicles with dynamic optimization and AI can reduce the number of trips without compromising on service levels. This improves coordination between logistics providers so that the same neighborhoods are not repeatedly visited by the same vehicles. This further aids in smoothing supply chain operations by anticipating demand Opens in new tab and mobilizing resources proactively.

Efficiency in distribution: In sorting and distribution centers, employing automation and cost minimization algorithms throughout the distribution process Opens in new tab (sorting, workforce allocation, scheduling, and routing) can produce superior and more structured solutions to demand unpredictability and cost-related problems. Such approaches can reduce the number of containers used, and consequently the number of vehicles for transportation. Further, with the advent of faster deliveries, new customers may need to be added to the existing solutions resulting in dynamic and complex problems. Automated routing solutions using machine learning (reinforcement learning Opens in new tab) and search heuristics can solve large-scale dynamic problems within minutes.

Building the sustainable enterprise

Organizations around the world are realizing that being sustainable does not necessarily mean losing profits. Using a combination of automation, AI-based optimization and alternate energy sources can help strike a balance between economic and ecological sustainability. The COVID-19 pandemic has accelerated the trend of automation, which is expected to last for a long time in the future.

IV.CONCLUSION

We believe that it is high time for enterprises to upgrade or overhaul their existing infrastructure and invest in re-skilling their employees. Doing so will provide long-term benefits of increased revenue at lower operating costs, better customer service, and collectively enable the move towards a greener planet. For the logistics and transportation functions, AI can provide a smooth transformation from the existing carbon-intensive processes to a 100% green fleet, without losing sight of economic realities.[10]

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