How Business Analytics Can Help Improve Supply Chain Efficiency in the US

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Abstract- ***This paper explores how business analytics can improve supply chain efficiency in the United States. Supply Chain Analytics analyzes historical and real-time data to uncover patterns, generate insights, and make data-driven decisions. Businesses can optimize inventory, plan capacity, deploy logistics solutions, and implement sound sales and operations planning processes by leveraging descriptive, predictive, prescriptive, and diagnostic analytics. Empirical evidence demonstrates the positive impact of business analytics on supply chain performance and organizational success. Future trends include integrating diverse data sources, adopting disruptive technologies, and focusing on building resilient supply chains. Implementing business analytics in supply chain management offers numerous benefits, such as improved decision-making, cost reduction, enhanced customer value, and increased productivity. Overall, business analytics is critical for optimizing supply chain operations and gaining a competitive advantage in the US.***

I. INTRODUCTION

Supply chain analytics is a powerful tool that helps businesses make data-driven decisions and improve their logistics and transportation processes [11]. It involves analyzing historical and real-time data from various touchpoints in the supply chain to uncover patterns, generate insights, and extract value [12]. It enhances the effectiveness and efficiency of supply analytics and is a critical component of a chain's ability to achieve its competitive advantage [2]. On the other hand, business analytics has been identified as an important “tool” for supply chain management [17] and optimization techniques have become an integral part of organizational business processes [12]. A correct relevant business decision based on bundles of huge volumes of both internal and external data is only possible with business analytics. It is therefore not surprising that research interest in business analytics use has been increasing [21].

Data and Analytics play a significant role in monitoring supply chain performance. Measuring inventory turns, order fulfillment rates, and delivery times enables executives to identify trends and make informed decisions. Building a digital foundation is crucial, as it forms the basis for introducing advanced automation and augmentation capabilities, facilitating process collaboration, and multi-enterprise data visibility [21]. Organizations can achieve several forward progress goals by working collaboratively with buyers and suppliers and leveraging advanced data tools. These include optimizing working capital through AI strategies, leveraging a tech-skilled workforce to transform manufacturing environments, ensuring production continuity through data insights into materials inventory, and strengthening buyer and supplier processes to reduce tail spending [12]. Artificial intelligence and machine learning are no longer mere buzzwords but have become everyday capabilities incorporated by manufacturers. By harnessing these tools, companies can align their supply networks for sustainable growth. Business analytics can help improve supply chain efficiency in the US [9].

II. OVERVIEW OF BUSINESS ANALYTICS IN SUPPLY CHAIN MANAGEMENT

In the context of supply chain management (SCM), business analytics refers to the application of advanced analytic techniques to data for solving supply chain management-related problems and answering questions [10]. It is a transformative technology that utilizes data, statistical methods, quantitative analysis, and predictive modeling to gain fresh perspectives and new insights into business

performance. The ultimate goal of business analytics is to enhance decision-making, drive profitability, and gain a competitive advantage for enterprises. As [15] suggests, business analytics encompasses three main types: descriptive analytics, which analyzes historical data to derive insights; predictive analytics, which uses statistical and machine learning techniques to forecast future outcomes; and prescriptive analytics, which employs optimization and simulation techniques to provide decision-making insights. The exponential growth of corporate data, commonly referred to as Big Data, presents a tremendous opportunity for leveraging business analytics. Enterprises are generating and managing an unprecedented amount of data, with billions of gigabytes produced from internal and external sources. The ability to effectively access and analyze this data is crucial for unlocking its value and providing actionable intelligence to enterprises [4]. Predictive analytics, in particular, plays a crucial role in building scenarios and anticipating outcomes in complex business environments influenced by factors such as globalization, outsourcing, and evolving customer preferences.

[16] emphasizes that business analytics (BA) is not a single technology but a combination of approaches, organizational procedures, and tools used to gather information, analyze it, and predict outcomes in the areas of supply chain planning, sourcing, manufacturing, and delivery (SCOR). Supply chain analytics plays a vital role in enhancing supply chain efficiency by analyzing data from various supply chain management applications. As pinpointed by International Institute in Geneva [7], there are four types of supply chain analytics:

- Descriptive analytics focuses on analyzing historical data to identify patterns and gain a better understanding of past events. It provides visibility into internal and external systems, enabling assessment of supply chain performance.
- Predictive analytics leverages historical data and statistical models to forecast future events and potential risks. It enables proactive decision-making, optimizing inventory levels, planning production, and ensuring smooth delivery channels.
- Prescriptive analytics goes beyond predicting future scenarios and recommends the best course of action for optimization. By considering various factors and their implications on the supply chain, it helps in making data-driven decisions.
- Diagnostic analytics assists in troubleshooting problems and identifying their root causes. It enables businesses to understand underlying issues affecting supply chain efficiency and take corrective measures.

Implementing supply chain analytics offers numerous benefits. It enhances decision-making processes by providing valuable insights and facilitating faster and more accurate decisions. Supply chain analytics helps in identifying potential risks, improving planning, reducing costs, optimizing inventory management, and meeting customer expectations [11]. By leveraging reports, dashboards, and visualizations generated through supply chain analytics, businesses can improve every aspect of the supply chain, leading to enhanced efficiency, reduced costs, minimized waste, and overall success in a competitive environment.

III. SUPPLY CHAIN EFFICIENCY

The influence of business analytics (BA) on supply chain (SC) performance is significant, as business analytics applies advanced analytic techniques to data for problem-solving and decision-making in supply chain management. It provides fresh perspectives and new insights into business performance, driving profitability and competitive advantage. The use of business analytics in supply chain management requires effective handling of large volumes of data, emphasizing the importance of data analysis in decision-making for SC management. Studies have shown that companies with mature supply chain practices and improved business analytics capabilities can reduce costs faster and achieve higher profit margins [14, 4]. Business Analytics is utilized in different areas of the supply chain, including planning, sourcing, making, and delivery to improve performance. Efficiency and resilience in the supply chain are crucial for business success, revenue optimization, and cost minimization. A streamlined supply chain forms the foundation for companies operating in the global economy and has implications

for their environmental footprint [1]. To enhance supply chain efficiency and resilience, the following best practices can be implemented:

i. Optimize Inventory

Implement an inventory management solution that ensures periodic stock control to avoid stockouts and overstocking. Optimizing inventory levels based on demand forecasts helps address unnecessary costs and problems like overstocking or stockouts. Real-time inventory analytics and technology-enabled demand forecasting enhance productivity and fulfillment efficiency.

ii. Plan Capacity and Sense Demand

Accurately predict future demand patterns by gaining real-time insights into capacity planning needs. Effective capacity planning balances resource utilization, inventory levels, and demand and supply synchronization to streamline operations, reduce bottlenecks, and meet supply chain demand. Leveraging demand sensing and a single source of truth further improves supply chain resilience.

iii. Deploy Logistics Planning and Management Solution

Utilize AI-powered logistics solutions to reduce complexities and develop logistics analytics. These solutions significantly improve logistics costs, inventory levels, and service levels. Logistics planning aims to link and synchronize the entire supply chain as a continuous process, enhancing connectivity and achieving time-driven outcomes such as faster decision-making, reduced cycle times, improved operations, and continuous improvement.

iv. Implement Sound Sales & Operations Planning Process (S & OP)

Establish a robust S&OP process that aligns supply chain strategy with sales and financial priorities while minimizing unnecessary costs. A well-executed S&OP enables better decision-making, financial analysis, and strategic planning across teams. By optimizing S&OP, supply planners can effectively utilize existing resources to meet customer needs and maintain profitability for growth.

Efficiency is crucial for supply chains as it reduces costs and ensures product availability. However, solely focusing on efficiency without considering resiliency can have disastrous consequences. The recent shortage of infant baby formula due to a production plant closure highlights the impact of supply chain disruptions on critical needs [9]. To prioritize efficiency, manufacturing shifted overseas, neglecting the need for redundancy and resiliency. This approach, influenced by cost-cutting and short-term financial gains, resulted in a lack of buffer stocks and inventories, leaving the country vulnerable during crises such as the COVID-19 pandemic. To build a more resilient economy, it is necessary to incentivize domestic industry through tax policies and federal guarantees, bringing critical supply chains back home. Discouraging unproductive corporate behavior like stock buybacks and intervening when foreign subsidies attract American jobs and production is also essential. Resilient supply chains are crucial not only for product availability but also for national survival, including critical infrastructure such as the electric grid. Building a resilient and productive economy involves creating stable, well-paying jobs that support families and communities, prioritizing the common good even if it means sacrificing some efficiency.

In the US, suppliers and carriers are seeking ways to streamline their operations due to the recent surge in domestic manufacturing and overall economic growth. The American truck driver plays a vital role in the US supply chain, moving a majority of the surface freight in North America. However, there are logistical challenges that need to be addressed to support continued economic growth. One major challenge is the inadequate state of the country's infrastructure, which cannot handle the high volume of traffic, resulting in additional costs and inefficiencies. Congested bottlenecks alone cause an estimated loss of around $75 billion per year for the trucking industry [6]. The increasing number of trucks on the road exacerbates the problem, as trucking accounts for approximately 70% of surface freight transportation in North America. Recognizing the significance of a functioning supply chain, recent economic policies emphasize the need to ensure its optimal operation in the US. The trucking industry, being a key driver of the economy, is committed to efficiently and effectively transporting products for clients. It is widely understood that when the nation's trucks are not moving, the American economy is also at a standstill.

IV. ROLE OF BUSINESS ANALYTICS IN SUPPLY CHAIN EFFICIENCY IMPROVEMENT

Supply chain management (SCM) stands to gain significant benefits from the application of business analytics. While traditional enterprise resource planning (ERP) and supply chain management (SCM) systems have primarily focused on transactional data, the introduction of supply chain analytics offers numerous advantages [20]. These advantages include improved customer engagement, increased productivity, enhanced responsiveness, better decision-making support, and cost reduction through improved inventory visibility and accurate demand forecasting. As supply chains become more complex with multiple partners, suppliers, and stakeholders, supply chain analytics provides advanced capabilities such as trend analysis, accurate forecasting, scenario analysis, and optimization [5].

Business analytics, which encompasses data analysis, statistical methods, quantitative analysis, and predictive modeling, has emerged as a powerful tool for enterprises to improve profitability and gain a competitive advantage [21]. It is being actively applied to various supply chain processes, including demand forecasting, inventory management, and production and distribution planning. The integration of business analytics with disruptive technologies like social media, cloud computing, and mobile technologies, collectively known as the SMAC stack, holds tremendous potential as the next wave in enterprise computing. This integration enables improved supply chain planning, collaboration, execution, and stakeholder engagement. Business analytics can be leveraged across multiple areas of supply chain management, encompassing inventory planning and management, sourcing and procurement planning, demand planning and forecasting, logistics and distribution planning and management, sales and operations planning, production planning, vendor and supplier selection and evaluation, risk management, and benchmarking [15]. By leveraging analytics in these areas, enterprises can achieve operational efficiency, enhance customer value, and gain a competitive edge in the market.

V. EMPIRICAL EVIDENCE FROM LITERATURE

The integration of diverse data sources poses a challenge for supply chain management (SCM), as data often exists in different formats and proprietary applications. However, the adoption of various business analytics tools and technologies has transformed enterprise workflows and processes, particularly in the realm of supply chain planning and execution. This integration has led to successful deployments of business analytics in supply chain management, resulting in increased agility, robustness, collaboration, visibility, and seamless integration of all stakeholders within the enterprise and the extended enterprise, including suppliers and customers.

[19] conducted a study to examine the relationships between supply chain practices, concerns, competencies, and their impact on organizational performance. The study focused on middle-line managers in the US and Taiwan to identify potential differences in perceptions and practices. The findings indicated that supply chain competencies positively influenced organizational performance in both regions. Supply chain practices had a direct impact on performance in Taiwan but had an indirect impact in the US. The study highlighted the importance of developing supply chain competencies and tailoring practices to specific contexts, guiding middle-line managers in optimizing organizational performance through strategic supply chain management.

In a cross-country study by [10], the role of big data analytics in transportation logistics in multinational companies worldwide was examined. The study revealed new opportunities for current supply chain practices by adding operational excellence and value. Through a survey conducted among staff members of multinational companies from the Americas and Europe, the study identified demand management, seller rating, and vendor satisfaction as the most important factors. The research also demonstrated that analytics significantly affect efficiency, operational excellence, customer service, and cost savings in the supply chain industry. The goal was to reduce the gap between demand management and supply chain management by improving customer

satisfaction, visibility, and value. The study emphasized the substantial value-added and monetary gains that big data can bring to companies, suggesting that its adoption will become more prevalent in the industry.

[14] investigated the relationship between analytical capabilities in different areas of the supply chain and company performance. The study also explored the moderating effects of information system support and business process orientation. Through the use of structural equation modeling and data analysis from 310 companies across various industries, the research revealed a significant relationship between analytical capabilities and performance. Information system support was found to have a stronger moderating effect than business process orientation.

The study emphasized that investments in the make area of the supply chain have the greatest influence on performance. Also, the findings provided insights into the impact of business analytics in different supply chain areas and underscored the importance of information system support and business process orientation as moderating factors, helping businesses leverage analytical capabilities to enhance supply chain performance.

[18] conducted a study comparing US and East Asian companies to understand the differences in supply chain management strategies and their impact on performance. The study focused on supplier and customer integration and its relationship to operational performance. The findings highlighted five distinct global supply chain integration strategies and demonstrated a strong correlation between higher levels of supply chain integration and improved performance. The study emphasized the strategic value of logistics and the need for effective supplier integration to maintain competitiveness. The practical implications included recommendations for companies adopting supply chain management and integrating with customers and suppliers, offering insights to improve decision-making and supply chain management practices.

[3] investigated the impact of supply chain analytics (SCA) on supply chain planning satisfaction and operational performance. The study defined SCA as the integration of data management resources (DMR), IT-enabled planning resources (IPR), and performance management resources (PMR). Through data collected from 537 manufacturing plants, the research examined the relationships among these resources, supply chain planning satisfaction, and operational performance. The results showed significant relationships between DMR and IPR, DMR and PMR, and a positive impact of SCA on supply chain planning satisfaction. Additionally, a positive relationship between supply chain planning satisfaction and operational performance was found. The study emphasized the importance of data management resources for successful supply chain analytics initiatives, as well as the need for investments in IT-enabled resources and organizational practices to achieve competitive advantage and improve operational performance.

VI. CURRENT POLICY AND FUTURE TRENDS

Business analytics plays a crucial role in improving supply chain efficiency by leveraging data and generating valuable insights. With the complexities of supply chain management, incorporating analytics helps businesses make informed decisions and overcome challenges [3]. Supply chain analytics can forecast future demands by analyzing records and patterns, allowing companies to optimize inventory levels, plan production, and ensure smooth delivery channels. Analytics also helps monitor inventory in real time, track shipments, and improve logistics, resulting in efficient operations and enhanced customer service [8]. Additionally, business analysts utilize technology to investigate supply chain operations, identify cost-cutting measures, reduce wastage, and offer real-time solutions to address issues promptly. Supplier relations can also benefit from analytics by predicting raw material availability and enabling informed decisions on ordering quantities.

Manufacturers should focus on external partnerships and internal operations transformation to enhance the supply chain. Sharing data with trusted suppliers provides valuable insights for optimizing the supply network, enabling informed decisions on sourcing materials [17]. [13] noted that improving industrial

supply chain management involves data-centric analysis, identifying efficiency gaps, and enhancing communication. Investing in advanced technologies like AI, IoT, machine learning, and robotic process automation improves efficiency and visibility. Real-time data tools aid in planning, execution, decision-making, and forecasting. Effective change management fosters continuous improvement by promoting a culture of improvement, addressing inefficiencies, and seeking optimization opportunities [2]. Close collaboration with suppliers and partners enhances planning and coordination through trusted data sharing.

CONCLUSION

Business analytics is a powerful tool that can help improve supply chain efficiency in the US. By analyzing historical and real-time data, businesses can gain insights, identify patterns, and make data-driven decisions. Supply chain analytics focuses on areas such as inventory optimization, demand forecasting, logistics planning, and sales and operations planning. Implementing business analytics in supply chain management offers benefits like improved decision-making, cost reduction, enhanced customer value, and increased productivity. Empirical evidence suggests that business analytics positively impacts supply chain performance and organizational success. Future trends indicate the integration of diverse data sources, the adoption of disruptive technologies like social media and cloud computing, and the focus on building resilient supply chains. Overall, business analytics has become a critical component in optimizing supply chain operations and gaining a competitive advantage in the United States.

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