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The Role of Business Intelligence adoption as a Mediator of Big Data Analytics in the Management of Outsourced Reverse Supply Chain Operations

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Abstract: The fluctuating and disorganized state of today's global markets is the result of several factors. COVID-19 is an illustration. Supply chain managers should re-evaluate their competitive strategy and leverage big data analytics in light of the rising volatility in demand and supply, rivalry among supply chain partners, and the requirement to deliver tailored goods and services (BDA). Supply chain firms require sophisticated BDA processes and procedures to provide useful insights from big data to better decision-making and supply chain operations, as many leaders in the sector have acknowledged the necessity for "improving with data" (SCO). This research gives theoretical justification for the influence that BDA has on SCO.

Keywords: Business Intelligence; Big Data Analytics; Reverse Supply Chain.

1 Introduction

The topic of business intelligence is getting greater attention in the global IT sector. There is greater value in corporations. As a result of BI, crucial information and procedures may be easily accessed and optimized. Employees will be able to make more informed judgements and accomplish jobs more quickly and accurately. Profits are increased, costs are decreased, risks are mitigated, and value is increased thanks to BI systems. Complex data sets are difficult to navigate in a BI system. Big businesses were curious about BI even before its full potential became clear. Less expensive business intelligence software is a boon for new businesses. Companies like SAP, Oracle, IBM, and others are in fierce competition with commercial start-up creators of new technologies. Parallel to this historical period, there has been a fourth wave of technology in manufacturing during the last decade [1] .

In order to make more informed decisions, many businesses are turning to big data and BDA for BI. Big data describe Very large data sets that cover a certain time period and geographical area. In the academic world, keeping up with the short shelf life and diminishing usefulness of huge data sets is an ongoing challenge. Big data comes in many sizes and shapes and can't be contained by just one academic discipline. The results of the data analysis can be trusted and used in practical ways. Adding truth and value to the "3 Vs" of volume, velocity, and diversity makes the new total the "5 Vs [2]

Data mining, statistical analysis and predictive analysis are all used in BDA to uncover useful patterns, correlations, and trends. [3] Write that business process and revenue enhancement is two areas where BDA is essential as big data continues to grow in importance. Business intelligence (BI) is a data-driven decision-making tool. Data warehouses that include online transaction processing systems, databases that focus on certain subjects, online analytical processing that analyses data in several dimensions, and data mining are the three main technology components of business intelligence [4,53]

There is some overlap between BI, data mining, and data analysis. Big data was expected as BI raw data expanded.

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Better business decisions may be made with the help of better business intelligence, which has to be restructured to better serve corporate needs. Throughout business processes, distinguishing between BI and BDA may be difficult. [5]
Given the high cost of gathering and analysing massive volumes of data, business intelligence (BI) is essential for deciding what data to gather, its scope, and the best way to put it to use. To do so effectively, it is helpful to understand and use the method based on case studies of actual businesses. These are the reasons for doing this study. Through a review of the existing literature, we first define business intelligence (BI) and big data analytics (BDA) and show how they all work together as an integrated decision-making framework. To further illustrate the value of BD and BDA in organisations business intelligence, a case study is presented. The case study is an expanding logistics courier company with a rich history.

Concept BDA and SCO

BDA improves both production-related intelligence and efficiency [6] Several studies have shown that BDA supports intelligent production systems, which hastens the rollout of Industry 4.0. emphasise the essentiality for working together to identify methods to wisely apply BDA in SCO, with the former proposing leveraging big data to be more practical and pragmatic[7,56]. [8]proposed a BD architecture for proactive preventive upkeep and analysed BD collection techniques in the industrial sector. The success of an I4.0 rollout is enhanced by proactive, preventive maintenance. The smart factory concept is an important part of the I4.0 design, and [9] proposed using BDA to help make it a reality. They presented a system for intelligent negotiation between smart shop-floor objects such as machines, conveyers, and items in order to facilitate the flexible manufacture of a variety of products. With the use of big data and AI, discussed how to determine the most effective path for delivering materials.

Correlates of Big Data Analytics, Business Intelligences and Big Data

By analyzing large amounts of data, a company may learn useful things via big data analysis (BDA)[10, 13]. [14] demonstrates that companies recognize the growing importance of and investment need in BDA. In fact, by making better use of big data, a business can boost its operational profit margin ratio by as much as 60% [12, 15]. The utilization of big data is proving useful in many facets of logistics, most notably supply chain management. Big data helps with product development, supply chain management, risk analysis, and customized service delivery. [16]
Before big data, there was a long history of research into business intelligence. [17,54] Analysis, insight, action, and performance monitoring are the four pillars of business intelligence (BI), as articulated by [4, 18] advocated for research and presented a BI framework. More studies were conducted when. Steel were cited by [17] in their study on manufacturing data management using enterprise and manufacturing intelligence.
Studies have previously focused on BI management and decision support systems, algorithms, and BDA computing. However, changes in the global economy, advances in technology, and the subdivision of academic disciplines are all expanding and broadening the scope of research. As a result, there have been many independent studies conducted on business intelligence (BI), big data analytics (BDA), and related topics. Importantly, issues about how to gather and harness the huge amount of data generated prompted a surge of interest in big data studies in 2012. Bi has been the subject of extensive research for quite some time.
Businesses have a hard time articulating what big data, BDA, and BI really are. With the help of an information value chain, BI gathers data, processes it into knowledge, guides management choices, impacts business results, and ultimately boosts the value of an organization. Researchers [19] argue that ICT and data storage have transformed "raw data" into "big data," and as a result, business intelligence (BI) and big data analytics (BDA) have come to live together as part of a single decision-support system for all phases of a company's operations, from data collection to executive deliberation.

Dimensions of Supply Chain Operations

- **Demand Planning:** One of the primary issues of operations management is demand forecasting, since this information is used in a variety of operational processes, including inventory decision-making and production planning [20] planning is fundamental to SCO planning, according to [9] which cite the usage of real-time sales, marketing, and inventory data from supply chain partners as a key factor in accurate demand and sales forecasting. Lack of real-time access to inventory levels, sales figures, customers' demands, and market segmentation makes demand forecasting challenging [21] Adding any anticipated unusual impacts and their possible sales consequences to formal demand estimates completes the transition from demand forecasting to demand planning.
- **Production and Manufacturing:** By minimising production waste, delays, and costs while satisfying customer demand, businesses may maximise profits[22, 23]. Most research has focused on integrated production, which includes distribution, inventory, and demand modelling [24] In order to maximise operational efficiency, production-supply chain integration is a must for the vast majority of industrial enterprises [25,60] Manufacturing now needs meticulous planning and sustainable, effective production networks due to the rise in product variety [26,57] To better satisfy customer demand, business managers optimise production by doing things like reducing waste,

making products and processes more sustainable, shortening lead times, anticipating and avoiding production disruptions, and reducing production costs [27]. When prioritising green production and manufacturing, decision-makers are taking energy consumption and energy-efficient production management into consideration [28]. Reducing energy use is another issue in the manufacturing sector.

- **Procurement:** The term "procurement" is used to describe the processes that facilitate the flow of goods and services between producers and distributors [29] reliable vendors has always been a challenge for managers [30] The prices that suppliers charge for products, materials, and labour may make or break a business [31] Calculating material quantities from numerous suppliers using the order allocation determination technique enhances both the cost efficiency of the company and its ability to pick suppliers [31] Many criteria and performance indicators are used to evaluate suppliers, striking a balance between quantitative and qualitative factors[32-34].
- **Inventory:** All components of the supply chain, both final and intermediate, are accounted for in stock. The lack of data transparency in inventory management hinders both responsiveness and traceability. Time-sensitive competition helps supply chains, but it complicates inventory management. Supply chain profitability is maximised at the appropriate inventory level, yet inspecting inventory is costly. Transportation delays, manufacturing delays, increased customization, and capacity limits all plagued the safety inventory as a result of demand and supply unpredictability. Maintaining the company's market position also includes satisfying a demand that exceeds projections.
- **Logistics:** Since consumer happiness has risen as a result of globalisation, online shopping, and the proliferation of businesses, there is a greater need for items that excel in these areas. To address the significance of logistical competence, analytics, and firm success, several academics have created knowledge-based logistics systems [35, 36]

Business Intelligence Adoption and Supply Chain Operations

Logistics, production scheduling, and stocking materials all fall within the purview of this SCO level. Every step of the supply chain—from sales to purchasing to production to upkeep—requires close coordination. There isn't a single company that always meets deadlines. 73 percent of buyers said they would cut ties with a supplier over a delivery problem; therefore, buyers appreciate this data. Since this is the case, it is standard practise for businesses to always seek ways to better serve their customers. When used in logistics, business intelligence helps pinpoint the causes and paths of persistent delays. With the use of technology, delays may be avoided and bottlenecks identified.

Managing incoming and outgoing materials and products

It is important to be ready to respond quickly to any operational issues that may arise. If you get subpar supplies, you could negotiate with your supplier and look for a new one. Your real-time dashboard might have a provider dispatch interface that makes BI data from your service providers easily accessible. In addition to answering questions like "Do you have enough raw materials?" with concrete data, technology also provides new insights. How many of tomorrow's cargoes still have no owners? You run the danger of shortages in raw materials, freight theft, late delivery, and more if you don't have a tracking system in place. Risk management in the supply chain is enhanced by BI.

Checking your supply chain's legality

In 2022, EU supply chain restrictions will become mandatory. Suppliers should be vetted for human rights abuses, conflict mineral trading, and other problems. Compliance with these criteria is both time-consuming and difficult without a BI system. Thanks to the digital chain formed by business intelligence, any supplier may be analysed at any moment. Specifically, what have you asked for authorization to do with this product, at what development stage, and with what documents? You may spend a lot of time running an Excel table to get this kind of information, and you might even convince yourself that you'll never make a mistake. Alternatively, you might use the BI system to build a database with details on new precursors and get regular updates on any changes to paint specifications.

Case Study I: Courier Services

Manufacturing is moving away from mass production of specialised items and toward small-scale manufacture of a wide variety of products in response to rising worldwide demand for customised services and more accessible goods. The need for courier services has increased dramatically in recent years due to the proliferation of internet shopping. Increases in ICT have also contributed to more people buying things online. In 2017, online retail sales in Korea topped KRW 79,954,478 million, up 21.85% from 2016's KRW 65,617,046 million and 107.69% from 2013. The logistics sector as a whole may take heart from this trend, but the courier service industry has reaped the greatest benefits. Logistics, as described by Tiffany, [37] was once expenditure and a necessary evil for manufacturing and consumption but is now the link between manufacturers and buyers. The courier service industry has expanded swiftly in response to the meteoric surge in package delivery. Technology in manufacturing is used to increase output in response to rising consumer demand[10, 38, 39]. Most courier companies will accept packages from customers, securely wrap them, carry them, and deliver them to their final locations. Typically, courier services are run by large, complex organisations that employ a large number of people and use a wide range of resources, including centralised

terminals, extensive computer networks, a fleet of cars, and an intricate system of drivers and vehicles. [40] investigated courier services through the use of logistics information technology. An efficient information system environment, as posited by [41] is one that reflects the system's impacts on individuals and groups. [42] used transit routes, freight distribution hubs, and brokerage sites to optimise package conveyance along major thoroughfares. To minimise transportation costs, capital expenditures, operational expenditures, and route costs, [43] suggested a model that takes all of these factors into account simultaneously.

Case Study II: CJ Logistics

CJ Logistics, the largest logistics company in Korea, is used in this study. Courier services rely heavily on the sorting process, so it's important to examine big data and BDA with BI. This involves analysing many aspects of the process, such as decisions made at loading docks and hub terminals [44]

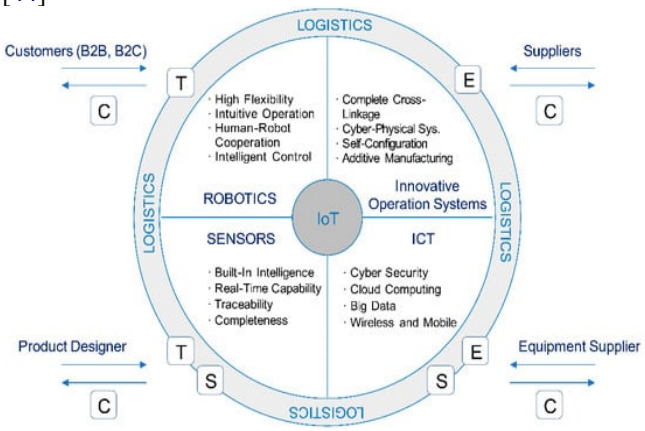

Fig.1: Technology, engineering, system and solution plus consulting (TES + C) of CJ Logistics.

Big data analysis can teach a company useful things (BDA). [14] shows companies recognize BDA's growing importance and investment need. Big data may boost operational profit margin ratios by 60%. Big data helps logistics, particularly supply chain management. Big data aids product development, supply chain management, risk analysis, and personalized service. With this funding, the corporation was able to expand its activities throughout northern Asia, especially in the provinces of Liaoning, Jilin, and Heilongjiang in China's northeast. The company has made substantial financial investments in order to expand its business, raising the bar for rivals and laying the groundwork for long-term growth CJ Logistics

CJ Logistics operates its courier service using both a hub-and-spoke model and a point-to-point strategy. Point-to-point delivery reduces wait times and helps with peak-load capacity. Port costs will rise in tandem with traffic levels, and inequitable distribution of traffic could push prices even higher. The hub of the hub-and-spoke system organises and distributes the items. This new technology decreases the amount of time people have to wait in the terminal without disrupting the flow of traffic. It could lead to supply delays during off-peak hours, necessitating a large central hub terminal[45,58]

This research is focused on loading and unloading dock alternatives due to the fact that CJ Logistics typically employs a hub-and-spoke system, with the logistics operation located at the hub terminal. Although this population has a higher potential for productivity and efficiency, relatively little study has been conducted on them. In addition, this may have been disregarded because standardisation is difficult because of factors like the physical separation between buildings and the irregular shapes of interior spaces. Courier companies often allocate loading and unloading docks at terminal hubs based on terminal criteria such as dock-to-dock distance and cargo volume. BDA and BI have helped CJ Logistics "see the unseen" and boost productivity and efficiency. The courier industry's hub terminal procedure was calculated using the three stages of operation: pickup, transportation/sorting, and delivery (Figure 2). This was the major strategy that [46] used to link up collecting points with final delivery addresses.

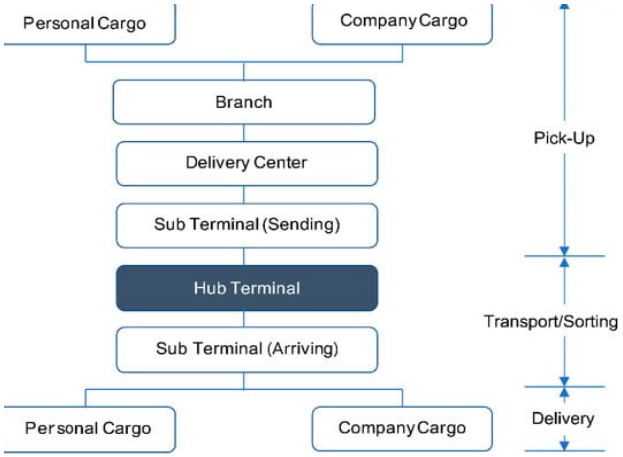

Fig.2. General Courier service structure Situations at hub terminals might cause delays in the whole pickup and delivery process.

Because of the potential impact on logistics, this must be addressed if the manufacturing sector is to advance. By addressing these and other concerns, big data has the potential to increase company productivity and efficiency.

Discussion and Conclusions

In order to get fresh insights and make breakthroughs from large data sets, BI may aid empirical and productive enterprises. The importance of big data depends on the context in which it is used [47-49]. Data quality and quantity are less important than the ability to transform raw data into actionable intelligence. As a result, it is essential to choose the kind of data to be acquired as well as its scope, taking into account the study's aims and foci. Using substantial data,

a medium-sized business has the potential to evolve into a market leader, while a huge organisation can protect its market position and guarantee its continued growth and competitiveness. Though business intelligence and big data analytics has all been the subject of substantial research, it is still up to enterprises to intuitively recognise that they need to be linked and employed in the management decision support system as a whole to implement changes [50-52,59]. Big data collection, analysis, and BI application are not autonomous processes, as shown by the CJ Logistics case study.

Data for this case study was gathered over a very short period of time; individual businesses' structures and environments vary greatly; and the sample size is too small to be representative of the whole industry. However, the lessons acquired from this case study may be immediately used by other logistics organisations in the same industry to enhance their own time and cost efficiency with minimal trial and error. In addition, our findings could be useful to the logistics industry and other firms by exposing strategies to improve their infrastructure without raising prices. CJ Logistics is using BI, big data, and BDA across the board in the hopes of gaining insights into the company's future directions and eliminating the need for trial and error. Future research might build upon these findings by collecting and sharing similar case studies, such as item volumetric analysis via an ITS (intelligent scanner), volume management through the bespoke production of boxes for each client, customer segmentation based on volume density, etc.

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