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Big Data Analytics and Demand-Information Sharing in E-Commerce Supply Chains: Mitigating Manufacturer Encroachment and Channel Conflict

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ABSTRACT

Big data analytics integration is a significant step forward for e-commerce supply chain management, especially when it comes to solving issues with manufacturer incursion and channel conflicts in dual-channel setups. In an effort to increase market reach and boost revenues, manufacturers are moving into direct internet platforms in addition to traditional retail avenues, thus diversifying their sales channels. But this tactic frequently sours relations with well-established merchants who have historically functioned as main distributors. E-commerce platforms are essential for reducing these difficulties because they use sophisticated analytics to draw useful conclusions from vast amounts of purchase and consumer behavior data. Strategically sharing demand information with manufacturers, these platforms improve operational efficiencies by anticipating market trends, optimizing inventories, and personalizing consumer interactions. This study looks at how big data analytics and information-sharing dynamics affect manufacturers' strategic choices in dual-channel supply chains, either by promoting cooperation with traditional retailers or by intensifying tensions. The impact of manufacturer strategies on channel disputes, the importance of e-commerce platforms in supplying trustworthy demand data, and the analysis of how risk preferences of manufacturers influence their involvement in information-sharing agreements are some of the main goals. To simulate interactions and improve supply chain performance, the study uses a multidisciplinary methodology that combines big data analytics, game theory, and supply chain management. This study emphasizes how big data may revolutionize modern supply chain management by giving stakeholders the knowledge they need to successfully navigate and utilize these dynamics. Alternative supply chain models and cooperative investment mechanisms could be the subject of future research to further improve e-commerce environments' efficiency and profitability.

Keywords: Big Data, Manufacturer Encroachment, Risk Aversion, Dual-Channel Supply Chain, E-commerce Platform, Demand Information Sharing, Channel Conflict.

INTRODUCTION

The implementation of big data analytics has brought about a paradigm shift in supply chain management, which has occurred within the context of the ever-changing landscape of e-

commerce. When it comes to tackling the issues that are presented by manufacturer encroachment and channel conflicts within dual-channel supply chains, this transition is particularly significant. To achieve their goals of expanding their market reach and boosting their profits, manufacturers are increasingly turning to direct online channels in addition to traditional retail avenues. On the other hand, this shift in strategy frequently results in tensions and disagreements with established shops that have traditionally functioned as their principal distributors.

The involvement of e-commerce platforms, which utilize big data analytics to extract actionable information from enormous databases consisting of customer behaviors, preferences, and purchase patterns, is essential to reducing the effects of these difficulties. E-commerce platforms are able to forecast market trends, optimize inventory management, and personalize customer interactions with an unparalleled level of precision when they make use of advanced analytics tools. Not only does this capacity improve operational efficiencies, but it also gives platforms the opportunity to strategically share precise demand information with manufacturers.
The purpose of this study is to evaluate the ways in which shared demand information and big data analytics can have an impact on the strategic decisions that manufacturers make in the context of dual-channel supply chains. The research intends to identify situations under which such activities might either enhance collaboration between manufacturers and traditional retailers or intensify tensions between the two groups. This will be accomplished by analyzing the dynamics of information-sharing agreements and the impact of risk preferences held by manufacturers. It is essential for stakeholders who are interested in navigating and capitalizing on the transformative potential of big data in the context of contemporary e-commerce supply chain management to have a solid understanding of these dynamics.

Analysis of Big Data in Electronic Commerce: A Technological Advancement
The ability to extract useful insights from massive datasets is made possible by big data analytics, which plays a crucial part in the development of e-commerce systems. This capability not only improves operational efficiencies but also makes it easier to make strategic decisions in a variety of disciplines, including customer service, marketing, and logistics, among others. Electronic commerce platforms are able to forecast market trends, optimize inventory management, and personalize consumer experiences by continuously gathering and analyzing data at the customer level. These kinds of capabilities are absolutely necessary in the highly competitive climate of today, where responsiveness and agility are of the utmost importance.

This study's main goal is to find out how demand-information exchange and big data analytics might lessen the negative effects of channel conflicts and manufacturer invasion in dual-channel supply chains that involve traditional shops and e-commerce platforms. The study's specific objectives are to:

- Determine the effect of manufacturer invasion methods on channel disputes in dual-channel supply chains.

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- Consider the significance of e-commerce platforms in providing reliable demand information to manufacturers in order to impact their strategic decisions.
- Evaluate how manufacturers' risk preferences influence their proclivity for incursion and readiness to participate in information-sharing agreements.
- Investigate the situations under which demand-information exchange can promote collaboration or increase tensions between manufacturers and traditional merchants.

Traditional retailers face substantial hurdles as a result of the incursion of manufacturers through direct internet channels, which in turn leads to exacerbated channel conflicts within dual-channel supply chains. The strategic choices that manufacturers make, which are determined by their risk preferences and the conditions of the market, have the potential to either ease or cause these conflicts to become more severe. In order to effectively devise strategies to alleviate channel conflicts and maximize supply chain performance, it is essential to have a solid understanding of the dynamics of information-sharing decisions that occur between e-commerce platforms and manufacturers.

Despite the fact that the existing body of literature recognizes the significance of information sharing in supply chain management, there is a lack of comprehension regarding the manner in which e-commerce platforms strategically employ big data analytics in order to influence the behavior of manufacturers and reduce channel conflicts. Previous research has generally concentrated on supply chain systems that are either single-channel or traditional. However, it has neglected to take into account the complications that are brought about by dual-channel dynamics and the role that advanced analytics plays in this context. The influence of the risk preferences of manufacturers on the decisions about information sharing and the ramifications of these decisions for the results of supply chain operations are still not fully understood.

Through the provision of a complete examination of the interplay of big data analytics, demand-information sharing, manufacturer invasion strategies, and channel disputes within e-commerce supply chains, the purpose of this study is to help bridge these gaps. The purpose of this research is to provide stakeholders who are interested in navigating and harnessing the revolutionary potential of big data in current supply chain management with actionable insights by explaining these dynamics.

2. LITERATURE SURVEY

According to Gee et al. (2020), the food system is changing as a result of changing supply chain configurations and e-commerce, with uncertain effects on the environment. Noting gaps in studies on delivery services, rural landscapes, transportation, consumer behavior, and food waste, their study highlights important changes and trade-offs. Food waste, rural areas, and the environmental effects of e-commerce on consumer behavior are important topics that require more research.

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Lin et al. (2020) investigate how the capability of e-commerce influences business agility in agribusinesses, giving them the opportunity to capitalize on the market and modify their operations more quickly. In contrast to dynamism, they discover that environmental complexity acts as a positive moderator of these effects. The lack of attention paid to agribusinesses in earlier studies on information technology is addressed in this study, which also emphasizes the significance of e-commerce in assisting these businesses to prosper in environment that is complicated.

Li and Huang (2019) investigate, using the theory of two-sided markets, the pharmaceutical e-commerce platforms' subsidy approach. They discover that platforms will only pay consumers' expenses if their net income is less than the whole amount that platforms and drug stores make together. Further supporting theory and offering guidance for making decisions about the sustainable growth of pharmaceutical e-commerce platforms is the study's demonstration that the maximum profit on the platform rises with the degree of network externality.

Liu et al. (2020) present a multi-objective optimization model for global closed-loop supply chain design and planning with unpredictable demand and recovery rates. The model considers network topology, entity capacities, product flow, and inventory levels to maximize economic, environmental, and social benefits. It solves customer demand prediction, product recycling, inventory management, and supply chain risk reduction. The model's usefulness is shown by a numerical example, and sensitivity analysis shows how demand and return rates affect performance. Maximum net present value, minimum CO2e emissions, and maximum social sustainability indicators are the objectives.

A supplier's choice to sell directly to customers can enhance supply chain transparency. Guan et al. (2020) investigate this effect. This can have detrimental repercussions for the supplier, but it also helps retailers by enabling them to profit freely from the provider's disclosures to raise customer standards for quality. The possibility of a less payout as a result of greater openness may cause the provider, even though they have the option, to decide against going after the retail market. The strategy for voluntary disclosure employed by the supplier and its effects on supply chain dynamics are highlighted in the paper.

The ideal moment to establish direct and wholesale prices in dual-channel supply chains is investigated by Matsui (2017). According to the study, if pricing is chosen deliberately, simultaneous price rivalry can be avoided. In order to attain a subgame perfect Nash equilibrium and optimize profits, it is recommended that the manufacturer publish the direct pricing either prior to or concurrently with determining the wholesale price for the merchant. In addition to maximizing manufacturer profits, this strategy balances the channel members' competitive dynamics.

The impact of strategic clients on pricing decisions in a sustainable supply chain is investigated by Liu et al. (2020). They discover that changing pricing and levels of greenness can lessen the impact

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that strategic clients have on vendor earnings and demand. Green products are becoming more and more popular, and businesses are trying to stay competitive by introducing new items, but this strategy may be complicated by the preferences of important customers. Customers are categorized by the study into three groups depending on their preferences: strategic, myopic, and other. It is possible to actively impact strategic customer behavior and enhance supply chain outcomes by adjusting price and greenness tactics to optimal levels.

Liu et al. (2020) present a multi-objective optimization model for creating a worldwide closed-loop supply chain with fluctuating demand and recovery rates. The model seeks to maximize economic, environmental, and social advantages by optimizing network topology, capacity, product flow, and inventory levels. It addresses the issues of anticipating customer demand and assuring precise product recycling in a worldwide market, all while lowering supply chain risks and effectively managing inventories. The objectives include maximizing net present value, reducing CO2e emissions, and improving social sustainability indices, as proven by a numerical example and sensitivity analysis.

Sandhaus (2019) investigate the changing environment of e-commerce, emphasizing its significant rise into a multibillion-dollar business over the last decade. While e-commerce is typically associated with online buying and digital payments, it also requires physical handling of commodities during production and distribution. The chapter investigates how e-commerce technologies supplement, rather than replace, physical logistics in supply chains. It dives into the deep relationships between e-commerce, logistics, and supply chain management, as well as developing technologies that influence commodities transportation and management.

Ghalehkhondabi et al. (2020) provide a comprehensive assessment of big data analytics in supply chain management from 2010 to 2019, focusing on its increasing popularity and future research potential. The paper indicates a large surge in research after 2017, with a primary focus on predictive analysis. This shift emphasizes big data's practical applications in improving company growth planning, market forecasting, and inventory management in supply chains. The report emphasizes the revolutionary impact of big data analytics on various aspects of supply chain operations.

Yu et al. (2017) investigate the existing condition and future possibilities of e-commerce logistics in supply chain management, focusing on the furniture industry. The article studies E-commerce logistics organizations in North America, Europe, and Asia Pacific, focusing on their innovations and strategies. It analyzes the adoption of future technologies such as the Internet of Things, Big Data Analytics, and Cloud Computing, highlighting their potential to transform E-commerce logistics over the next decade. The study provides useful insights and practical lessons for academics and furniture industry professionals looking to improve their understanding of effective E-commerce logistics and supply chain management strategies.

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3. METHODOLOGY

The methodology section describes the research design, data collection methods, model development, simulation techniques, and analytical framework used to study the role of big data analytics and demand-information sharing in reducing manufacturer encroachment and channel conflicts in e-commerce supply chains. This multidisciplinary method combines game theory, supply chain management, and big data analytics to provide a thorough understanding of strategic interactions among important players.

3.1.Research Design

The study uses a quantitative research design to investigate complicated interactions in dual-channel supply chains that include manufacturers, traditional retailers, and e-commerce platforms. The research intends to provide actionable insights into strategic decision-making and supply chain optimization in the digital transformation era by combining theoretical and empirical data.

3.2.Theoretical Framework

Game Theory and Supply Chain Dynamics

The study's primary premise is the use of game theory to describe strategic interactions among stakeholders. Game theory provides a solid framework for understanding decision-making under uncertainty, especially in competitive situations where producers and merchants' interests may clash. Key topics include:

Modeling manufacturer strategies such as incursion, in which a manufacturer skirts middlemen in order to sell straight to customers, and dependence on established distribution channels are examples of strategic interactions that take place inside supply chains. In addition to having a substantial impact on channel dynamics, these techniques also have an effect on relationships, competition, and the behavior of the market as a whole.

An essential component of forecasting stable outcomes based on strategic choices and payoffs is equilibrium analysis, which encompasses both Nash equilibrium and subgame perfect equilibrium. In order to improve their positioning and performance, firms can anticipate the responses of their competitors by analyzing these equilibria and then change their strategy appropriately.

$$Nash\ Equilibrium: (s_1^*, s_2^*, \dots, s_n^*) \quad (1)$$

where s_i^* represents the strategy for player i that maximizes their payoff given the strategies of the other players.

Conflicts and inefficiencies are frequently the result of information asymmetry, which plays a significant role in supply networks. Improving the level of coordination and trust among partners in the supply chain requires doing an analysis of the ways in which decisions on information

sharing can help minimize these challenges. Ensuring that incentives are aligned, reducing uncertainties, and improving overall supply chain performance are all possible outcomes of effective information sharing. The development of more robust strategies to navigate complicated supply chain environments and gain sustained competitive advantages can be accomplished by firms if they address the components listed above.

3.2.1. Big Data Analytics in E-Commerce

Big data analytics is integrated into the research framework to provide empirical insights from massive datasets. Big data analytics makes possible a number of crucial tasks:

Demand Forecasting: By using predictive analytics, one may forecast market demand and identify trends in consumer behavior. Through the examination of past data and the identification of trends, companies can enhance their forecasting skills and minimize surplus inventory by making more precise projections.

$$D\hat{}_{t+1} = f(D_t, \dots, D_{t-p}) \tag{2}$$

where $D\hat{}_{t+1}$ is the forecasted demand at time $t+1$, and D_t,…, D_{t-p} are historical demand data up to time $t-p$.

Personalized Marketing: By utilizing machine learning algorithms, marketing techniques may be customized according to the tastes and actions of individual customers. By presenting people with offers and products that are relevant to them, personalization improves customer happiness, boosts sales, and makes marketing efforts more successful.

Operational Efficiency: Data-driven insights improve supply chain operations, logistics planning, and inventory management. Businesses may ensure that the correct items are available at the right time and place, streamline operations, cut costs, and improve overall efficiency by using big data analysis.

3.3. Data Collection Methods

3.3.1. Primary Data Collection

Semi-structured interviews and structured surveys are used to gather primary data from stakeholders in e-commerce supply chains. Manufacturers, conventional retailers, and owners of e-commerce platforms are among the participants. The following are the main goals of this data collection process:

Collect Views: Gain insight into the opinions of stakeholders on channel disputes brought on by manufacturer incursions and competitive circumstances. Researchers can obtain a full

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understanding of how various entities perceive and experience disputes throughout the supply chain by gathering these observations.

Analyze Information-Sharing Practices: Determine perceptions of the influence of information sharing on supply chain performance as well as attitudes toward it. Determining possible enhancements in efficiency and coordination requires an understanding of the degree of trust and information sharing across stakeholders.

Recognize Strategic Reactions: Determine strategic reactions to pressures from the competition, market uncertainty, and technical breakthroughs. This involves investigating the ways in which stakeholders modify their approaches to maneuver through the dynamic terrain of e-commerce, confront challenges posed by competitors, and capitalize on technical advancements to uphold or improve their market standing.

3.3.2. Secondary Data Sources

Academic literature, industry reports, and case studies are examples of secondary data sources. These resources offer theoretical frameworks, factual data, and historical viewpoints on a range of subjects including supply chain management, e-commerce tactics, game theory applications in business, and big data analytics. The validation of theoretical assumptions and the contextualization of empirical insights within broader industry trends are two ways that secondary data analysis enhances primary findings.

3.4. Model Development: Game-Theoretic Approach

3.4.1. Game-Theoretic Model Construction

To simulate the strategic interactions between stakeholders in dual-channel supply chains, a game-theoretic model is constructed. The model includes:

Decision variables include how manufacturers choose to act (by encroaching on new channels or relying on old ones), what e-commerce platforms do (by sharing information), and how retailers react (by setting prices and managing their supplies).

Manufacturers' risk preferences (levels of risk aversion), changes in market demand, the accuracy of demand predictions based on big data analytics, and the way competition works are some of the factors that are taken into account.

3.4.2. Strategic Choices and Payoffs

Game theory examined strategic choices and the rewards of different actions in the decision-making process for direct online sales (encroachment) vs established channels. Manufacturers have techniques to handle these choices. E-commerce platform decisions also consider information

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sharing incentives and supply source coordination. Retailers modify pricing, product stockpiling, and promotions to combat competition and market volatility. This holistic analysis shows how supply chain stakeholders interact and adjust their strategies to improve performance and resolve issues.

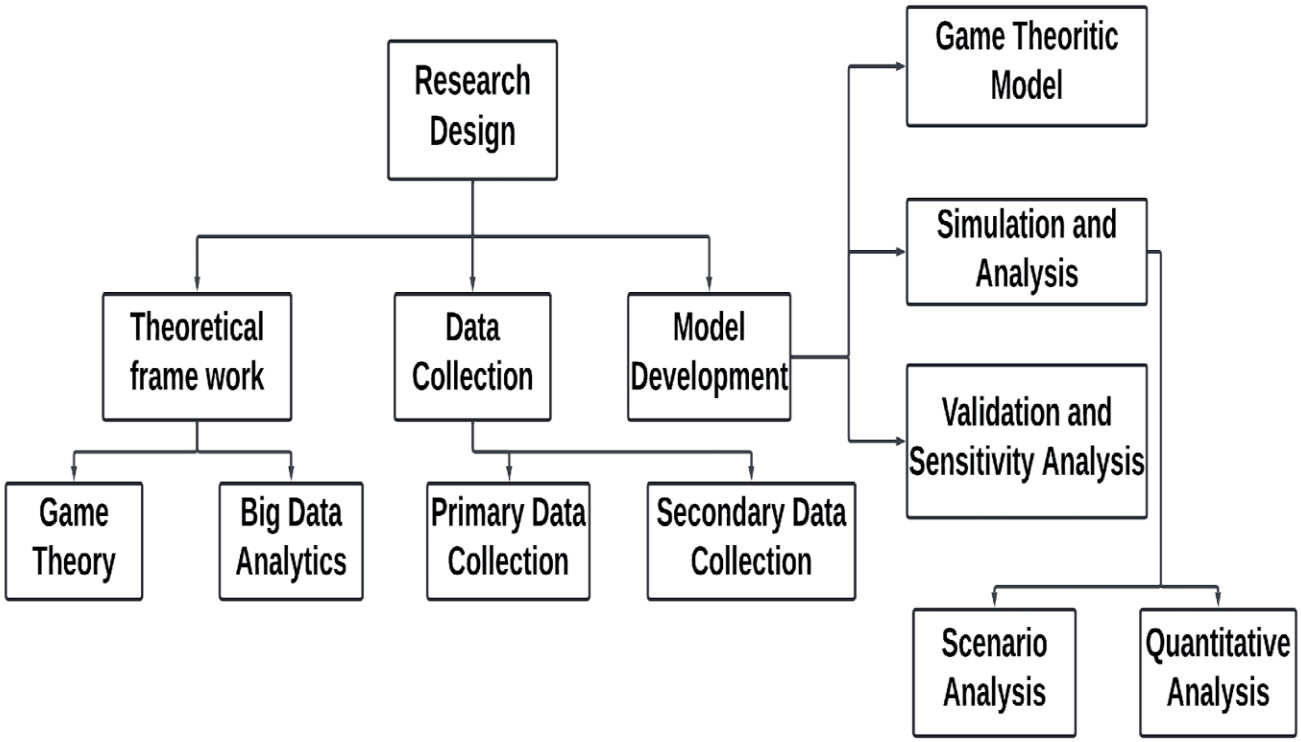

Figure 1: Research Methodology for E-Commerce Supply Chains.

The research approach utilized to examine demand-information exchange and big data analytics in reducing manufacturer invasion and channel conflict in dual-channel supply chains is shown in this flowchart. The theoretical framework, data collecting, model construction, simulation analysis, validation, and sensitivity analysis are the final steps before returning to the research design. The way each phase is linked together shows how thorough the process is in analyzing strategic connections and improving supply chain performance.

3.5. Simulation and Analysis

3.5.1. Scenario Analysis

The study uses simulation to examine how parameters affect supply chain outcomes:

In simulation scenarios, different variables are assessed according to information-sharing tactics, market demand volatility, and manufacturing risk aversion levels. Researchers can observe how

manufacturers and other supply chain stakeholders could respond in various scenarios by modeling them.

Key variables including channel conflicts, supply chain performance (e.g., profitability, market share), and strategic equilibrium circumstances can all be quantitatively evaluated by outcome analysis. This analysis aids in comprehending the possible effects on the supply chain of various strategic decisions and environmental variables. Through the analysis of these results, companies may choose the best course of action, reduce risks, and improve overall performance when dealing with unpredictable markets.

3.5.2. Quantitative Analysis

Empirical validation and quantitative insights into the following are provided by statistical analysis of survey data and simulation results:

Impact of Big Data Analytics: This entails evaluating how well big data analytics improves supply chain efficiency and the accuracy of demand forecasting. Businesses may increase the accuracy of their forecasts and enhance other areas of their supply chain, such logistics planning and inventory management, by utilizing large-scale datasets.

Information-Sharing Dynamics: This field examines the motivations behind information exchange and how they might help supply chain participants work together more effectively by reducing conflict. Improved supply chain efficiency and coordination can result from an understanding of the motives underlying information sharing.

Strategic Decision-Making: This entails determining optimal strategies for manufacturers, retailers, and e-commerce platforms using game-theoretic equilibrium concepts and simulation results. By utilizing these theoretical frameworks, stakeholders may make more informed decisions that improve their competitive positioning and overall supply chain performance.

3.6. Architectural Framework for Big Data Analytics

3.6.1. Infrastructure and Capabilities

An architectural framework defines the infrastructure and capacities of e-commerce platforms in using big data analytics:

Online transactions, browser behavior, and social media interactions are used to acquire customer data. This extensive data collection gives a rich analysis dataset.

Data Storage: Scalable, cloud-based storage solutions transform data management by securely storing large amounts of data and providing real-time access for analysis and decision-making. These technologies improve scalability and accessibility, which are critical for enterprises

handling massive datasets. Organizations can optimize storage resources by employing cloud infrastructure, resulting in effective data processing that meets dynamic needs while improving overall operational agility and responsiveness.

Data Processing: Data processing using machine learning algorithms and predictive modeling yields actionable insights that improve operational efficiency and customer engagement. Firms can gain a competitive advantage in dynamic marketplaces by using data to enable demand forecasts, targeted marketing strategies, and better inventory management.

Variable/Parameter	Description
Manufacturer Encroachment	Strategy to engage in direct online sales
Manufacturer Risk Aversion	Degree of aversion to uncertain outcomes
E-commerce Information Sharing	Decision to share demand information with manufacturers
Market Demand Fluctuations	Variability in customer demand over time

Table 1: Summary of Game-Theoretic Variables and Parameters.

Risk Aversion Level	Channel Conflict Severity	Supply Chain Performance
Low	Moderate	Improved
High	High	Worsened

Table 2: Simulation Results: Impact of Manufacturer Risk Aversion on Channel Conflict.

3.7. Validation and Sensitivity Analysis

Validation: To determine the relevance and resilience of the results, model predictions are checked against industry benchmarks and real-world case studies. Researchers can confirm that the model is accurate and applicable to real-world circumstances by contrasting expected results with actual data.

Sensitivity Analysis: This involves determining how sensitive the model is to changes in important variables like demand volatility and incentives for sharing information. Businesses may comprehend which aspects have the greatest influence on their operations and modify their plans accordingly by identifying the major drivers of supply chain outcomes and strategic decisions.

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4. RESULT AND DISCUSSION

The analysis demonstrates that manufacturer encroachment in dual-channel supply chains is influenced by the e-commerce platform's demand information sharing and varies with the manufacturer's risk preferences. Shared information benefits risk-neutral producers by raising profitability across both channels and decreasing conflicts. Risk-averse producers, on the other hand, face more channel conflicts despite higher direct sales. The quality of demand information and market volatility have a considerable impact on these outcomes, with bigger advantages reported for increased volatility and exact information. Overall, the study highlights the importance of big data analytics and strategic information sharing in improving supply chain performance and minimizing conflicts.

Table 3: Impact of Manufacturer Risk Aversion on Channel Conflict.

Title	Explanation
Manufacturer Encroachment	The strategy of manufacturers selling directly online, bypassing traditional retailers.
Risk Aversion	The degree to which manufacturers are averse to uncertain outcomes in their strategic decisions.
Demand Information Sharing	The practice of e-commerce platforms sharing consumer demand data with manufacturers to improve supply chain efficiency.
Channel Conflict	Tensions between manufacturers and traditional retailers due to direct online sales by manufacturers.
Game-Theoretic Analysis	A methodological approach used to model strategic interactions and predict outcomes in the supply chain.

5. CONCLUSION AND FUTURE SCOPE

The analysis concludes that manufacturer encroachment invariably results in channel conflicts. E-commerce platforms are more likely to share demand information with manufacturers who use the platform for direct sales, because the information's value is realized through online transactions. The ability of demand information to ease channel conflicts is dependent on the manufacturer's risk aversion, market demand variability, and data accuracy. Accurate demand information helps risk-neutral producers avoid conflicts. Conversely, for risk-averse producers, such knowledge may intensify tensions while increasing direct channel profitability. Increasing risk aversion often shifts profitability from the manufacturer and e-commerce platform to the traditional retailer, hence reducing channel conflicts. Future research could look into other supply-chain models in which manufacturers and e-commerce platforms such as JD sell products. Furthermore, examining the cost of big data investment and collaborative investment mechanisms may result in Pareto improvements, increasing overall efficiency and profitability in these supply-chain models.

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