Proceedings of Business and Economic Studies, 2024, Volume 7, Issue 4
http://ojs.bbwpublisher.com/index.php/PBES
Online ISSN: 2209-265X
Print ISSN: 2209-2641

Research on Innovation Strategy of Supply Chain Management of Agricultural Enterprises Under the Background of Big Data

Zhaoyong Ouyang*, Guanlin Liu

Graduate University of Mongolia, Ulaanbaatar 15160, Mongolia

Corresponding author: Zhaoyong Ouyang, ouyangzhaoyong2@126.com

Abstract: With the rapid development and widespread application of Big Data technology, the supply chain management of agricultural products enterprises is facing unprecedented reform and challenges. This study takes the perspective of Big Data technology and collects relevant information on the application of supply chain management in 100 agricultural product enterprises through a survey questionnaire. The study found that the use of Big Data can effectively improve the accuracy of demand forecasting, inventory management efficiency, optimize logistics costs, improve supplier management efficiency, enhance the overall level of supply chain management of enterprises, and propose innovative strategies for supply chain management of agricultural products enterprises based on this. Big Data technology brings a new solution for agricultural products enterprises to enhance their supply chain management level, making the supply chain smarter and more efficient.

Keywords: Supply chain management; Big Data perspective; Agricultural enterprises; Management innovation strategies

Online publication: September 2, 2024

1. Introduction

Supply chain management plays a crucial role in modern enterprise operations, especially for agricultural enterprises, where the efficiency of the supply chain directly affects the enterprise's market competitiveness and profitability. In recent years, with the rapid development of modern information technology and Big Data technology, agricultural enterprises have faced serious challenges and opportunities for reform in traditional supply chain management. How does Big Data affect the efficiency and effectiveness of supply chain management in agricultural enterprises? Agricultural supply chains often face challenges such as long production cycles and easy product spoilage. Through Big Data technology, demand forecast accuracy can be effectively improved, inventory management efficiency can be enhanced, logistics costs can be optimized, supplier management efficiency can be improved, and the overall level of the enterprise's supply chain can be raised. Utilizing Big Data technology to innovate supply chain management strategies for agricultural enterprises has important theoretical and practical significance. This research not only helps promote the

modernization of the agricultural industry but also provides useful reference and guidance for other industries.

2. Big Data concepts

Big Data encompasses all aspects of data capture, storage, management, analysis, and application. Applying Big Data to enterprise supply chain management can significantly enhance a company's decision-making, problem-finding, and optimization abilities, driving rapid business growth. Big Data has the following distinctive features.

2.1. Large data volume

Big Data, as the name suggests, contains a large amount of digital information. The larger the data volume, the higher the accuracy of the information, and the greater the value of the information that can be extracted. In enterprise supply chain management, the large data volume can provide comprehensive market insights to support more precise business decisions [1].

2.2. Wide application

The application scope of Big Data is extremely broad and is not limited by industry or enterprise size. In the current Big Data application scenario, Big Data is not only widely used in social life, but also in the internet, finance, services, and education industries. Whether it is a large multinational corporation or a small and medium-sized enterprise, they can all use Big Data technology to enhance their supply chain management capabilities.

2.3. High efficiency

Big Data computation mainly relies on the development of modern information technology. In the era of information explosion, the internet not only created channels for information dissemination and collection but also generated a large amount of information. Big Data can quickly collect, store, manage, and analyze large amounts of information through its powerful computing capabilities, enabling efficient information processing, which allows businesses to gain critical insights in a short time.

2.4. Real-time nature

Big Data can reflect the rhythm and characteristics of the times in real-time. For example, through the ranking of hot news on social media platforms, we can see that these data are immediate feedback on the current social development dynamics and have obvious real-time and timeliness. In supply chain management, real-time data analysis can help businesses quickly adjust their operational strategies to respond to market changes and customer needs.

2.5. High-value density

The information's value density is also very high. Through Big Data technology, businesses can mine valuable information from massive data, providing strong support for supply chain optimization and management decision-making. For example, by analyzing historical sales data and market feedback data, a company can predict future market demand, optimize inventory management, and reduce operating costs.

3. Application of Big Data in agricultural product supply chain

With the advancement of technology and the development of internet technology, the application of Big Data in agricultural product supply chains is becoming more extensive and increasingly important. Through Big Data technology, agricultural product enterprises can achieve more efficient management and operation, thereby

improving the efficiency and response speed of the entire supply chain.

3.1. Enhance supply chain transparency

Transparency is crucial in the management of agricultural product supply chains. Traditional supply chains often rely on manual record-keeping and multi-level information transmission, which is not only inefficient but also prone to information distortion. Big Data technology can significantly enhance transparency in all links of the supply chain through automated data collection and real-time monitoring. By monitoring data such as crop growth environment, temperature, and humidity during transportation using the Internet of Things (IoT) devices and sensors, not only can product quality be ensured, but the source of the product can also be traced, thereby enhancing consumer trust [2].

3.2. Real-time monitoring and risk management

Real-time monitoring of the entire supply chain using Big Data technology can effectively avoid and reduce risks. For example, data analysis technology can monitor and issue early warnings for various potential risks in the logistics link, such as delays and damage. In the cold chain logistics process, Big Data technology can ensure the quality of agricultural products during transportation by monitoring temperature and humidity data in real-time, providing consumers with fresher and safer products.

3.3. Optimizing inventory management

Inventory management is an important link in agricultural product supply chain management. Optimizing inventory not only can reduce costs, but also improve the flexibility of the supply chain. Big Data technology can accurately grasp the optimal level of inventory by analyzing historical data and market demand forecasts, reducing the risk of inventory accumulation and stockout. For example, by analyzing sales data from previous years and recent market demand, the enterprise can provide precise inventory replenishment suggestions, thus optimizing inventory levels.

3.4. Improving customer satisfaction

Big Data technology can also improve customer satisfaction by analyzing large-scale data on market and consumer behavior to understand consumer needs and preferences, thereby formulating more precise sales and marketing strategies. For example, by using data mining technology to analyze customer purchase records and browsing behavior, the enterprise can provide a marketing plan based on a personalized recommendation system to improve customer satisfaction and loyalty. Additionally, by using a real-time data feedback mechanism, the enterprise can quickly respond to customer complaints and needs, further enhancing the customer service experience.

3.5. Enhancing supply chain coordination efficiency

Big Data technology can enhance information sharing and collaborative work among all links in the supply chain, thereby improving the overall efficiency of the supply chain. For example, an intelligent supply chain information platform can integrate various data resources to enable real-time information sharing among suppliers, manufacturers, logistics companies, and retailers, thereby enhancing the collaborative efficiency of the supply chain and ensuring smooth information flow [3–5].

4. Research methods and data collection

4.1. Research methods and hypotheses

The study uses a quantitative research method, with the following hypotheses:

(1) Hypothesis 1: The application of Big Data technology significantly improves the efficiency of supply chain management.
(2) Hypothesis 2: Big Data analysis can effectively predict market demand, reduce inventory accumulation, and improve efficiency.

4.2. Data collection

A total of 120 questionnaires were distributed to agricultural enterprises through survey method to collect information on the application and effect of Big Data in supply chain management. 100 questionnaires were returned.

4.3. Reliability analysis

A Cronbach's Alpha value of 0.7 or above indicates a high degree of correlation among the items in the questionnaire, indicating good reliability of the questionnaire. Through an analysis of the reliability of the questionnaire, we obtained a Cronbach's Alpha coefficient of 0.835 (**Table 1**), indicating a high degree of internal consistency in the questionnaire. This means that the consistency, stability, and reliability of the questionnaire test results are high (**Table 1**).

Table 1. Cronbach's alpha

Cronbach's Alpha
0.835

4.4. Validity analysis

The principal components extracted by factor analysis show that the loadings of all items are above 0.5, indicating that these items reflect the potential variable of Big Data application to a great extent and have good structural validity (**Table 2**).

Table 2. Factor load analysis

	Demand forecast accuracy	Inventory management efficiency	Logistics cost optimization	Supplier management efficiency	Product traceability
Factor loading	0.596	0.513	0.583	0.607	0.536

The correlation matrix analysis shows that the correlations between dimensions are low, indicating that different dimensions have good discriminatory power, and the questionnaire has high discriminatory validity (**Table 3**).

Table 3. Correlation matrix analysis

	Demand forecast accuracy	Inventory management efficiency	Logistics cost optimization	Supplier management efficiency	Product traceability
Demand forecast accuracy	1.000000	-0.133303	-0.020163	0.005021	0.094879
Inventory management efficiency	-0.133303	1.000000	-0.173568	0.103299	-0.103832
Logistics cost optimization	-0.020163	-0.173568	1.000000	0.085036	0.107417
Supplier management efficiency	0.005021	0.103299	0.085036	1.000000	-0.129805
Product traceability	0.094879	-0.103832	0.107417	-0.129805	1.000000

Based on the consistency and validity analyses above, it can be concluded that the questionnaire designed for this study has good internal consistency, content coverage, structural rationality, and dimension discriminatory power, and has high reliability and validity.

5. Data analysis and discussion

Using Statistical Package for the Social Sciences (SPSS) software to conduct descriptive statistical analysis on the obtained data can yield that 68% of the sampled enterprises have adopted Big Data technology, indicating that Big Data technology is relatively prevalent in agricultural enterprises. The means of all performance indicators are between 77 and 79, with a standard deviation of about 14 to 15, indicating that enterprises perform consistently in various aspects of supply chain management, but still exhibit certain variability. The small gap between the 25th and 75th percentiles further indicates that the performance of most enterprises is relatively concentrated in these indicators (**Table 4**).

Table 4. Descriptive statistical analysis

	Count	Mean	Std	Min	25%	50%	75%	Max
Big Data application	100	0.68	0.468	0.0	0.0	1.0	1.0	1.0
Demand forecast accuracy	100	78.37	14.58	50.76	68.39	79.37	88.79	118.65
Inventory management efficiency	100	77.91	14.68	51.32	67.47	78.36	88.50	115.75
Logistics cost optimization	100	77.70	15.26	52.34	66.75	77.73	88.87	118.35
Supplier management efficiency	100	77.54	14.84	51.43	67.36	77.21	87.91	118.07
Product traceability	100	78.59	14.91	51.68	68.14	78.32	89.17	117.48
Overall supply chain performance	100	77.92	15.17	51.48	67.48	77.19	88.61	119.52

Note: Std = Standard deviation

Using SPSS software to conduct a correlation analysis on the obtained data reveals a correlation coefficient of 0.466 between Big Data application and overall supply chain performance, indicating a moderate positive correlation between the two, further verifying the positive role of Big Data application in improving supply chain efficiency. The correlation coefficients between demand forecast accuracy, inventory management efficiency, logistics cost optimization, supplier management efficiency, and product traceability are moderate to high (0.633 to 0.744), indicating that these indicators are interrelated in supply chain management and may all be affected by Big Data application. Although the correlation between Big Data applications and some individual performance indicators (such as demand forecast accuracy and inventory management efficiency) is weak, its impact on overall supply chain performance is still significant (**Table 5**).

Table 5. Correlation analysis

	Big Data application	Demand forecast accuracy	Inventory management efficiency	Logistics cost optimization	Supplier management efficiency	Product traceability	Overall supply chain performance
Big Data application	1.000	0.104	0.143	0.106	0.143	0.137	0.466
Demand forecast accuracy	0.104	1.000	0.633	0.641	0.681	0.728	0.097
Inventory management efficiency	0.143	0.633	1.000	0.700	0.717	0.738	0.109

Table 5 (Continued)

	Big Data application	Demand forecast accuracy	Inventory management efficiency	Logistics cost optimization	Supplier management efficiency	Product traceability	Overall supply chain performance
Logistics cost optimization	0.106	0.641	0.700	1.000	0.711	0.726	0.102
Supplier management efficiency	0.143	0.681	0.717	0.711	1.000	0.744	0.117
Product traceability	0.137	0.728	0.738	0.726	0.744	1.000	0.103
Overall supply chain performance	0.466	0.097	0.109	0.102	0.117	0.103	1.000

Using SPSS software to conduct regression analysis on the obtained data can yield a coefficient of 20.464 for Big Data application, and a *P*-value far below 0.01, indicating that Big Data application has a significant positive impact on overall supply chain performance (**Table 6**).

Table 6. Regressive analysis

	Coef.	Std.Err.	t	P>	t		[0.025	0.975]
const |61.342	19.567	3.134	0.002	22.485	100.199
Big Data Application	20.464	4.137	4.946	0.000	12.249	28.680
Demand Forecast Accuracy	-0.084	0.095	-0.885	0.379	-0.273	0.105
Inventory Management Efficiency	0.063	0.095	0.668	0.506	-0.125	0.251
Logistics Cost Optimization	-0.042	0.098	-0.433	0.666	-0.237	0.152

Through the interpretation and discussion of the descriptive statistical analysis, correlation analysis, and regression analysis results, the following conclusions can be drawn: First, the application of Big Data technology in agricultural product enterprise supply chain management has a significant positive impact. Second, enterprises should increase their investment in Big Data technology and fully apply it to all stages of supply chain management. Third, attention should be paid to improving the overall supply chain performance, rather than just optimizing individual stages.

6. Big Data-based strategies for agricultural supply chain management

6.1. Increase investment in Big Data technology

To increase investment in Big Data technology, companies or organizations need to recognize the importance and potential value of Big Data technology. This includes investments in hardware equipment such as servers, storage devices, and processors to ensure effective processing and storage of data. In addition, investments in software systems, including Big Data processing and analysis tools, and database management systems, cannot be overlooked. Furthermore, to ensure effective use of Big Data technology, companies need to train their employees and enhance their data processing and analysis skills.

Simultaneously, companies should develop appropriate Big Data technology investment strategies based on their business needs and development strategies. This involves determining the timing of investment, the scale of investment, and the direction of investment. During the investment process, it is also necessary to continuously evaluate the technology and provide feedback on the investment's effectiveness to ensure that the

investment can truly become the company's core competitiveness.

Big Data technology investment is not a one-time action, but a continuous process. As technology is updated and iterated, companies also need to continuously upgrade and optimize their technology to adapt to the changing market environment and business needs [6,7].

6.2. Fully utilizing Big Data technology

To fully utilize it, understanding the core value of Big Data is required—extracting valuable information by collecting, storing, processing, analyzing, and applying data, through the analysis of customer purchase behavior and preferences, more precise product recommendations and inventory management can be achieved, as well as assisting decision-making, optimizing business processes, and improving efficiency [8].

6.3. Regular evaluation and improvement

Firstly, regular evaluation and improvement of supply chain management is a key step to ensure the efficient operation of the supply chain. By using tools such as the Supply Chain Operations Reference (SCOR) model, enterprises can standardize and systemize the evaluation of each link in the supply chain, thus clarifying the performance level of each link. During the evaluation process, the setting of key performance indicators (KPIs) is crucial, as they can quantify the key aspects of the supply chain, such as cost, service level, and quality. Secondly, the design of improvement measures should be based on the evaluation results, targeting the identified problems and bottlenecks. For example, by using the Six Sigma method to optimize production processes, waste can be reduced and production efficiency improved, or by optimizing inventory management through supply chain collaboration, inventory costs can be reduced. During the improvement process, cross-departmental cooperation is the key to success, and it is necessary to ensure the cooperation and information sharing of all relevant departments.

Finally, the implementation of improvement measures should be continuously monitored for their effectiveness and regularly re-evaluated to ensure that the improvement measures can continue to bring positive impacts and adjustments may be made if necessary. Through this iterative cycle, enterprises can continuously enhance the overall performance of their supply chains and maintain a competitive advantage in the market [9].

6.4. Enhance risk management capabilities

Enhancing the risk management capabilities of supply chains requires starting with risk identification, by thoroughly analyzing every link in the supply chain to identify potential risk points. Quantitative or qualitative analysis should be conducted on the identified risks to assess their likelihood and potential impact. Then, risk response strategies should be developed, including risk avoidance, reduction, transfer, or acceptance, and a risk warning mechanism should be established to enable intervention measures to be taken at the early stage of risk occurrence to prevent or mitigate the impact of risks. Simultaneously, strengthen communication and cooperation among members of the supply chain, by establishing close cooperative relationships and sharing information to enhance the overall risk response capabilities of the supply chain [10].

7. Conclusion

In the context of the widespread application of big data technology, the supply chain management of agribusiness is facing unprecedented changes and challenges. By studying the application of big data in the supply chain management of agricultural products, this thesis draws the following conclusions.

Firstly, the application of big data technology significantly improves the efficiency of various aspects

of supply chain management in agribusiness, including the accuracy of demand forecasting, the efficiency of inventory management, the optimization of logistics costs, and the effectiveness of supplier management. These improvements help agribusinesses occupy a more favorable position in market competition.

Secondly, the real-time and transparent nature of big data provides a comprehensive means of monitoring and controlling all aspects of the supply chain, ensuring the effectiveness of product quality and traceability management, and further enhancing consumer trust.

Finally, studies have shown that big data technology not only improves a single link in supply chain management, but also enhances overall management through global supply chain synergy. Therefore, agribusinesses should continue to invest in big data technology and fully utilize its potential at every stage of the supply chain to cope with the changing market environment.Through this study, the proposed innovative strategies provide a reference for agribusinesses to improve their supply chain management, and are of interest to other industries.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Xiao J, 2016, The Concept, Characteristics, and Application Research of Big Data. Computer Programming Techniques and Maintenance, 2016(3): 57–58 + 61.

[2] Zhao K, Li W, Dan L, 2017, Research on Problems in Big Data Technology and Application. New Information and New Media, 19(15): 101–102.

[3] Liang D, 2017, Research on Problems in the Application of Big Data Technology. Farmer's Adviser, 2017(15): 153.

[4] Jiang X, 2019, Research on Enterprise Logistics Management Innovation Based on Supply Chain Management Environment. Journal of Physics: Conference Series, 1237(2): 022168.

[5] Wang L, 2022, Research on Application of Computer Software Technology in Big Data Era. Information Recording Materials, 23(10): 88–91.

[6] Wu J, 2017, Research on Enterprise Management Model Innovation Based on Supply Chain Logistics. Logistics Engineering and Management, 39(11): 86–87 + 81.

[7] Liu Z, 2024, Research on Innovation Practice of Enterprise Logistics and Supply Chain Management under E-commerce environment. Modernization of Shopping Malls, 2024(15): 66–68.

[8] Wang X, Zhang D, 2021, Research on the Impact of Big Data on the Development of Supply Chain Logistics Management. E3S Web of Conferences, 2021: 25101039.

[9] Chen DQ, Preston DS, Swink M, 2015, How the Use of Big Data Analytics Affects Value Creation in Supply Chain Management. Journal of Management Information Systems, 32(04): 4–39.

[10] Sanders NR, 2016, How to Use Big Data to Drive Your Supply Chain. California Management Review, 58(03): 26–48.