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Exploring the Influence of AI-Driven SC Efficiency on Customer Experience in Retail: A Data-Driven Approach to Enhancing Front-End Operations

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Abstract: Improvement of customer experiences is the prime agenda of today's competitive retailing, and the efficiency of the backend supply chain (SC) plays a very important role in helping to reach this goal. The present research study at the backend SC processes and their interlink with the front-end customer satisfaction of the retail sector, with special emphasis on the integration of technologies driven by AI. This research estimates the contribution of AI-powered tools, like predictive analytics, automated inventory management, and logistics optimization, to the enhancement of operational efficiency and into customer experience, through data. The chief objective is to demonstrate the beneficiary of AI tools to elevate operational efficiency and consumer satisfaction. Through evaluating key performance metrics composed of product availability, speed of order fulfillment, and service quality, this research study will show both direct as well as indirect ways streamlined backend operations that shape customer satisfaction and loyalty. The current study uses mixed methods that combine both quantitative as well as qualitative approaches. The quantitative data gathered from 114 retailers through structured questionnaires is examined by the SPSS software tool. The analysis was performed using SPSS version 27, applying statistical methods such as correlation, ANOVA, and regression. The qualitative data was collected from 15 experienced retailers and evaluated through thematic analysis. The findings also forecast the criticality of backend efficiencies in delivering seamless and responsive front-end customer experience. The present research provides actionable insight for retailers desirous of optimizing AI adoption in SC management with a view to engendering long-term customer loyalty and competitive advantage.

Keywords: *AI, Supply Chain, Consumer experience, Mixed method, Consumer loyalty*

1. Introduction

1.1 Background of study

Retail is constantly changing in response to relentless advances in technology, ever-evolving consumer behavior, and increasingly fierce competition among the international trade (Sagar, 2024). The time has passed when simply offering a good product at reasonable prices was enough to secure customer loyalty. Additionally, more sophisticated, informed and demanding consumers of today than ever before (Nurhilalia & Saleh, 2024). Their expectation is for a seamless, personalized, and captivating experience at every stage, from the initial product search to the final delivery and beyond (Y. Zhang, 2024). With consumer expectations shifting, retailers are having to rethink their strategies and prioritize providing exceptional experiences.

E-commerce has made customer experience more crucial (Darboe, 2022). Unlike physical stores, online retailers have taken on the responsibility of providing convenience and personalized service (Ratchford, Soysal, Zentner, & Gauri, 2022). Due to the shift in consumer preferences, retailers are now able to offer similar convenience and customization options across all retail channels, blurring the boundaries between online and offline retail. This has led to an almost identical situation. A comprehensive customer experience that fosters brand values and loyalty is essential in the omnichannel world (Rusnaini, Ariyanto, Jessika, Pratiwi, & Marlina, 2024).

It is challenging to provide satisfying customer experiences in the face of a complex retail environment (Bansal, 2023). The challenges that retailers face include the diverse range of consumer interactions between retailers, including those on websites, mobile apps, social media, and physical stores (Gauri et al., 2021). The difficulty lies in managing fragmented customer journeys and maintaining consistency across all touch points (Pal, 2024). It is challenging for numerous retailers to gather, integrate, and scrutinize customer data in a proper manner. But the lack of data-driven insights makes it difficult for them to personalise conversations so they can deliver relevant offers directly to individual customers. The combination of outdated technology, inefficient processes, and disruptions in the SC can result in stockouts, delayed deliveries, or frustrated customers. New businesses are constantly competing with established brands in the retail industry. Retailers are compelled to lower prices due to increased competition, which can negatively impact their margins

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and hinder their ability to invest in improving customer experiences (Babin, Feng, & Borges, 2021).

The resolution of these challenges necessitates a complete overhaul of retail operations, with heightened emphasis on utilizing technology, data, and inventive approaches to enhance the customer experience at every stage of the purchase process. While the front-end operations, such as store design, marketing campaigns, and customer service, are emphasized, the backend SC is crucial to the overall customer experience (Grewal, Gauri, Roggeveen, & Sethuraman, 2021). During the SC, which involves from source origin to final consumer destination, important factors such as product availability, order completion timeframes, delivery timelines and overall service quality are all heavily influenced by the process (Mondol, 2021).

Properly planned and optimized SCs lead to a high level of success, with the right products being delivered at the appropriate time and place for optimal sales opportunities (Sallam, Mohamed, & Mohamed, 2023). The ability for retailers to fulfil orders quickly and efficiently allows for prompt delivery of products. The delivery is guaranteed to be delivered correctly and damaged, reducing customer frustration and the possibility of returns. The basis for ensuring consistent service quality across all channels is essential in building trust and loyalty among customers.

Alternatively, SC inefficiencies can be detrimental to the quality of service that customers expect. The consequences of stockouts include reduced sales and a rise in customer frustration, leading some to seek out competitors (Jean, 2024). Delays in deliveries can harm brand reputation and undermine customer confidence (Akturk, Mallipeddi, & Jia, 2022). Misleading orders can lead to expensive returns and unhappy customers. Distinctive service quality can weaken brand image and diminish customer loyalty. A poor SC is not acceptable in today's demanding retail environment where customers expect seamless, frictionless experiences (Ishfaq, Davis-Sramek, & Gibson, 2022). To ensure the satisfaction of their customers, retailers must prioritize investments in technologies and strategies that optimize SC operations. Moving away from reactive SC management, organizations must adopt a more proactive, data-driven, and customer-centric approach.

Today's retail industry is reliant on Artificial Intelligence (AI) to transform SC operations and deliver exceptional customer experiences (Oosthuizen, Botha, Robertson, & Montecchi, 2021). A range of powerful tools and techniques, including AI, can aid in enhancing visibility, streamlining processes, and facilitating data-driven decision-making across the SC. From logistics and transportation to demand forecasting and inventory optimization, AI-based SC management solutions are changing the game. Historical sales figures, market trends and activity on social media, as well as external factors like weather patterns, are all analysed by AI algorithms that can forecast demand more accurately than traditional methods (Anica-Popa, Anica-Popa, Rădulescu, & Vrîncianu, 2021). The retailers can reduce waste and stock outs while maintaining optimal inventory levels. Additionally, it ensures that customers receive the right products when they need them. The use of AI algorithms allows for ongoing monitoring of inventory levels across the SC, identifying potential imbalances and suggesting improvements to stock level management. This results in lower carrying costs, less obsolescence, and product availability that can meet customer demand.

The use of AI-powered robots and automated systems improve warehouse automation, automating tasks like picking, packing, and sorting. Consequently, it reduces labour costs and improves efficiency while reducing errors which allows for faster order fulfilment and delivery. By Analyzing traffic patterns, weather conditions and delivery constraints, the AI algorithms create more efficient routes and time-efficient delivery (Cao, 2021). By doing this, costs can be decreased, delivery times reduced significantly, and logistics efficiency is enhanced. With the help of AI-powered recommendation engines, customers can receive tailored product recommendations and offers by Analyzing their data about their browsing history and purchase patterns. This results in increased customer engagement, sales growth, and brand loyalty. SC logistics are monitored by AI, which can track product movements (D. Zhang, 2024), identify potential disruptions such as weather events or supplier delays, and generate alerts in real-time. Additionally, artificial intelligence is utilized to monitor the SC. It empowers retailers to take prompt action when problems arise, minimize disruptions, and ensure efficient SC management (Goswami et al., 2025).

Retailers can not only optimize their SC processes through AI to reduce costs but also enhance customer experience and loyalty by leveraging AI for long-term growth. Nonetheless, the implementation of AI in SC management requires a strategic and integrated approach that prioritizes data quality, talent development, and organizational alignment. This study seeks to provide insights into how retailers can use artificial intelligence to improve their SC operations, customer satisfaction in the digital world.

1.2 Significance of the study

By examining the relationship between SC efficiency and customer experience in retail, this study provides substantial empirical evidence that AI-driven SCs can optimize their supply systems to improve customer satisfaction and loyalty. This provides retailers with a useful tool to use artificial intelligence, overcome implementation obstacles, and optimize backend SCs through strategic means. The research examines the relationship between SC metrics and customer loyalty to inform more effective decision-making, resource allocation, and targeted action. In summary, this research contributes to academic knowledge and enables retailers to use AI for competitive advantage, leading to improved customer experience and long-term growth in the fast-paced retail industry.

1.3 Problem identification

With the advent of AI-powered SCs and increased customer engagement, retailers are increasingly relying on their ability to provide exceptional customer experiences (Patil, 2024). In spite of this, there is still a significant issue: the direct correlation between specific AI implementations in the SC and quantifiable improvements in customer satisfaction and loyalty remains unclear. This gap creates a significant challenge for making smart investments, as AI adoption becomes fragmented and its potential benefits are not fully realized. Backend efficiencies are not always translated into actual benefits for customers, leading to poor customer journeys and missed opportunities for differentiation. This is particularly challenging for retailers. Unless retailers understand how AI-powered SC improvements directly affect the way customers perceive and behave, they cannot effectively allocate resources for investment or optimize their AI strategies. To tackle this issue, this research investigates the precise links between AI-driven SC efficiencies and essential customer experience metrics. By measuring these connections, the study will offer retailers a valuable resource to help them invest in AI and optimize their SC operations, ultimately driving higher levels of

customer satisfaction, loyalty, and competitive positioning. Its aim is to bridge the gap between technology capabilities and customer focus, allowing retailers to make significant use of AI in the fast-changing retail industry

1.4 Research objective

The objective of the present study is elaborated below:

- To assess the significance of AI and data analytics technology in the optimisation of SC operations.
- To investigate the challenges retail businesses face in adopting AI-driven SC solutions that directly impact the customer experience.
- To evaluate the correlation between efficiencies metric of the SC and consumer loyalty in the retail sector.
- To evaluate the extent to which AI-driven SC efficiencies influence customer satisfaction and experience in the retail sector.
- To recommend the framework for the improvisation of the back-end SC in the retail sector.

1.5 Research questions

The research questions are summarized below:

1. How does the deployment of AI and data analytics impact the optimization of the SC in the retail industry?
2. To what extent will AI-enabled tools, such as predictive analytics and automated inventory management, lead to improved operational efficiency and customer satisfaction?

1.6 Research Hypothesis

The hypothesis of the present research study are as follows:
H1: AI and data analytics have a significant impact on the optimisation of SCO
H10: AI and data analytics do not have a significant impact on the optimisation of SCO
H2: Challenges of AI implementation are prevalent in the retail sector
H20: Challenges of AI implementation are not prevalent in the retail sector
H3: There is a significant correlation between efficiencies metric of the SC and consumer loyalty
H30: There is no significant correlation between efficiencies metric of the SC and consumer loyalty
H4: AI driven SC has significant impact on the consumer satisfaction
H40: AI driven SC do not have significant impact on the consumer satisfaction

1.7 Paper organisation

The paper is ordered in the following structure in which section 1 offers elaborated introduction concerning the effectiveness of AI practices in the retail sector. Furthermore, the first section clarifies the importance of research. In section 2, prevalent research works correlated with current study will be reviewed. The present study's research methodology will be elucidated in section 3. In section 4, the result of the analysis will be discussed. In section 5, the present study's result will be deliberated with existing studies and the limitation of the present study will be explained. Lastly, section 6 brief inferences concerning the current study will be reflected with future recommendations.

2. Literature Review

The existing study (Fu, Chang, Lin, Teng, & Huang, 2023) examined the selection and evaluation mechanism for effective adoption of AI technology in the retail industry. The identification of factors and multifaceted measurements allowed retailers to implement AI technology successfully and maintain a competitive advantage. The conventional study implemented quantitative research approach and gathered data through survey method from senior managers of retail stores using questionnaire. The outcome indicated, major factors for the adoption of AI in the retail. The high management focus more on factors associated with business performance compared to internal functional efficiency. The study determines; retailers are more concerned on organisation and technology matter which are under retailer's limit rather than concentrating on other environmental aspects which are uncontrollable factors in the business.

As information technology evolves, so does the degree of competition on a global level. Many companies have predicted that the future of operation and SC management could be radically different from just planning, scheduling, optimisation to transportation, thanks to the rise of AI. The interest of people in machine learning, AI, and other intelligent technologies will grow with SCM. This research study (Helo & Hao, 2022) provides a brief overview of the concept of AI and SCM within this context. The focus is on conducting timely and critical analyses of SC research and applications that are influenced by AI. This exploratory research investigates the advancement of AI-based business models in various case companies. The value of their AI solutions and its correlation with companies is also evaluated. Therefore, this study highlights multiple areas where AI can be utilized to create value in the SC. Additionally, it presents an approach to crafting business strategies for AI SC implementations.

The existing study (Cao, 2021) explored AI benefits to retailer including strategies, offering solutions and value creation. The study used grounded theory of multiple case analysis from 54 AI implemented and adopter retailers from a period of 2008 to 2018 to examine the organization's AI benefits. Resulted, 5 strategies for AI based data management were found, and 28 AI solution which influenced business's process involving the four-logic creation such as hyper-personalisation, automation and complementarity. The study concludes, retail managers develop a better strategy while adopting AI in business.

The existing study (Bhagat, Chauhan, & Bhagat, 2023) determined to explore the features affecting AI practical implacability and its influence on customer's purchase intention in online platform. Implemented a technology model to explore various features affecting customers' purchase intention in e-retailing. The model demonstrated the integration of AI in retailing through business organisation. Furthermore, examined subjective norms, consciousness and faith as constructs that improve the AI implacability. The outcome revealed AI positively impact customer's purchase behaviour. The consciousness towards online shopping influenced customer to analyse and shop the products on grounds of usefulness and merit of the items.

The human factor in decision making in digitalized retail SCs is still evolving. (Brau, Sanders, Aloysius, & Williams, 2024) conducts comprehensive interviews with 25 executives across the retail SC ecosystem, the present research study aim to compare managerial positions in a pre-COVID and post-COP21 context. The four main contributions by applying grounded theory. Initially, the managerial judgment is found to be increasingly embedded in the retail SC, shifting away from the customer and demand signal. The primary method of decision making is the integration of analytics and judgment and identify essential components for success. The third objective is to establish a crucial framework for successful integration. It seeks to identify the

essential elements for a successful process in AI implementation. The research study provides important insights into the use of analytics and AI in decision-making, as well as opportunities for researchers to understand the changing role of the human factor in digitalized retail SCs.

The prevailing research (Adapa, 2024) examine the impact of AI-driven demand forecasting on SC optimization in the retail sector. In the face of escalating complexity and competition in retail, operational efficiency necessitates accurate demand forecasting. Due to the unpredictable nature of demand, conventional forecasting methods are inadequate in managing inventory and fulfilling orders efficiently. Researchers are exploring the use of advanced AI models such as LSTM, ARIMA, and Random Forest to enhance SC performance and forecasting accuracy. They focus on these areas. By utilizing data from various retail industries, the study employs a quantitative approach to evaluate the impact of AI models in different sectors. Following the implementation of AI, there has been a notable increase in forecasting accuracy, inventory management, and order fulfilment rates. In particular, the LSTM model was found to be most accurate with the least amount of forecast error, leading to significant reductions in inventory discrepancies and improved order fulfilment rates. The study highlights performance-based indicators, such as sales volume, inventory turnover rate, and stockout occurrences, which all show significant improvement after the implementation of AI. The findings implies that it has the potential to surpass conventional forecasting, leading to significant cost reductions and operational effectiveness for retail businesses.

2.1 Research Gap

- The existing study (Cao, 2021) has limited to secondary data and is not considered primary which may have contributed to better understanding.
- The prevailing research (Brau et al., 2024) performs interview with 25 representative and lack comprehensive analysis.
- The existing study (Adapa, 2024) has conducted quantitative analysis and failed to evaluate the AI beneficiary in diverse retail sectors.

3. Methodology

3.1 Research Design

The research design is supposed to implement several processes, including tools and procedures to obtain data for research purposes. Well-designed research is mandatory to acquire reliable and valid outcomes. It incorporates the appropriate method of approach for the present study through responding the questions (Baur, 2019). The process of offering a complete and précised framework on what the research process is illustrated as research design. The current study employs quantitative research approach; this method designates the happening through collected numerical and constant data which are evaluated using statistical approaches. This offers statistics related to questions and incorporate the logic and objective. The quantitative method execute survey method (Sürücü & MASLAKÇI, 2020) to collect primary data with aid of questionnaire which are on basis of study variables and queries to implement the analysis (Mohajan, 2020).

3.2 Study Area

The study is conducted among retailers, who are willing in the contribution of the survey. It supports for useful execution of the present study and the survey conducted with the aid of respondents. The study specifically focused on people who can share the knowledge regarding effectiveness of AI in terms of SC operations. This will enhance the significance of the study and makes the course of gathering data more convenient and fast.

3.3 Sample size and population

For any kind of study, the sample size is supposed to be finalized after appropriate analysis with an intention of acquiring precise as well as generalized outcome. In the present research, the appropriate respondent contribution will be selected to range the obtaining data regarding the effectiveness of AI in the retail sector. The gathered valuable data for the quantitative technique depends on the selected sample size which helps to prove study objectives (Lakens, 2022). The study got response from 114 respondents for quantitative and 15 retailers for qualitative, which includes AI to know and understand the major factors that influence effectiveness in process.

3.4 Sampling Techniques

The technique used for sampling is a most significant course to congregate the data from targeted populace instead of focusing on complete population available (Stratton, 2021). The current study performed purposive sampling method to choose the target respondents for the study. Correspondingly, the data to be gathered for the current research chose the samples who are willing and have ability to offer precise responses and measured. Applicable sampling techniques help in deriving samples to reinforce the objective of present research. Also, it is used to find the perception of dataset for the purpose of categorizing the patterns which allows to comprehend (Sreekumar, 2023).

3.5 Data Collection

Data collection process is a main phase in the research which affect the value of attaining outcomes through decreasing the feasible faults which might arise in the process of research (Taherdoost, 2021). In our present study, data are collected from retailers with the help of structured questionnaires to discover the effectiveness of AI while focusing in terms of management, perception and standard adherence.

3.6 Data Analysis

Quantitative research approach is designated as a systematic phenomenon by collecting data and performing computation, statistical and mathematical approaches (Jung, 2019). This method is employed to collected data from respondents and define the results to targeted population (Dzwigol, 2020). The result of the quantitative method is numerical, and those values are interpreted to predict the appropriate conclusion for the findings. The quantitative data attained through structured questionnaire is examined by SPSS software tool. The gathered data are exported into MS-Excel sheet for see-through study variables.

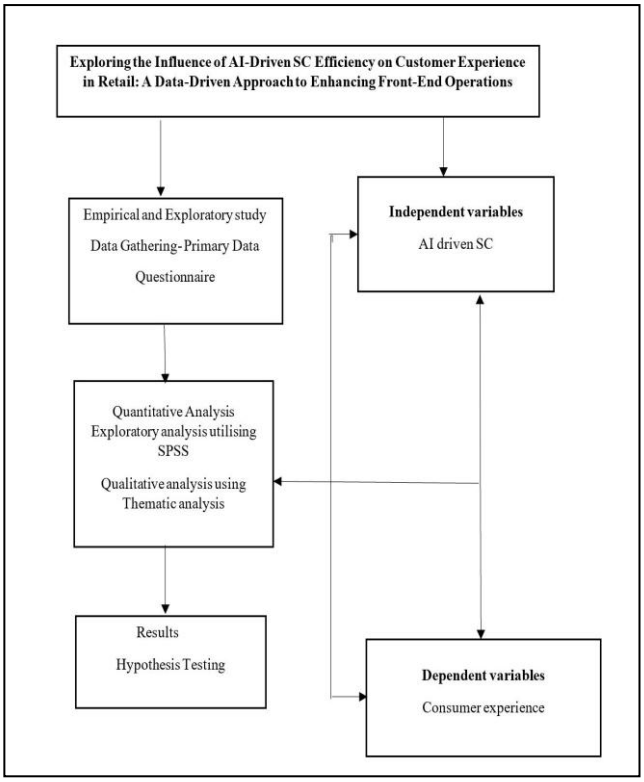

Figure 1 Research Design

The above figure demonstrates the process incorporated in the present study for quantitative data analysis using SPSS software where study variables are determined and executed. In Thematic analysis, the response from the interview is analyzed based on the questions asked to them. The important keywords are obtained based on the responses of the interviewee. Each question and the keywords obtained from the respondents are related to the current study on the impact of AI in the retail sector.

4. Result

4.1 Demographic data

114 retailers were considered as the contributors for the current research survey. The demographic particulars of the participants are illustrated below:

Table 1 Demographic Profiles

Demographic factor	Parameter	No. of respondents	%
Gender	Male	76	66.7
	Female	38	33.3
Age	18 to 25 years	21	18.5
	26 to 35 years	38	33.3
	36 to 60 years	46	40.4
	Above 60 years	9	7.8
Marital Status	Married	81	71.1
	Single	33	28.9
Education	Under graduate	20	17.6
	Post graduate	82	71.9
	Doctorate	12	10.5
Experience	1-5 years	25	21.9
	6-10 years	29	25.4
	11-15 years	34	29.8
	More than 15 years	26	22.9
Employment status	Permanent	68	59.6
	Temporary	11	9.6
	Contract basis	22	19.3
	Trainee	13	11.5

Table 1 presents the demographic profile of the 114 respondents in this study. The sample is predominantly male (66.7%) with a significant female representation (33.3%). The age distribution shows a concentration in the 36-60 years category (40.4%), followed by the 26-35 years category (33.3%), suggesting a sample comprised of a mature workforce. The 18-25 age group accounts for 18.5%, while those above 60 years represent 7.8%. The majority of respondents are married (71.1%) compared to single individuals (28.9%). In terms of education, a substantial proportion holds a postgraduate degree (71.9%), with smaller representations of undergraduates (17.6%) and doctorate holders (10.5%), indicating a highly educated sample. The work experience is relatively evenly distributed across categories, with 11-15 years being the highest (29.8%), followed by 6-10 years (25.4%), 1-5 years (21.9%), and more than 15 years (22.9%). Most of the respondents are permanent employees (59.6%), while the temporary, contract basis, and trainee statuses account for 9.6%, 19.3%, and 11.5% respectively.

4.2 Statistical Analysis

Hypothesis 1

H1: AI and data analytics have a significant impact on the optimisation of SC

$H1_0$: AI and data analytics do not have a significant impact on the optimisation of SC

Regression

This test is utilized to govern the arithmetic quantity of concepts. Additionally, the examination is utilized to evaluate the inference among the study construct that encompasses independent as well as dependent construct (Alita, Putra, & Darwis, 2021). Furthermore, the present study applied regression assessment to examine the effect AI and data analytics on the SC optimization.

Table 2 Model

Model	R	R^2	Adj. R^2	SE
1	.475[a]	.225	.211	.688

a. Predictors: (Constant), Data analytics tools have enhanced our ability to forecast customer demand accurately. The use of AI technologies has led to better inventory management in my organization.

Table 3 ANOVA[a]					
Model	SOS	df	M^2	F	S
R	15.297	2	7.648	16.152	.000[b]
Re	52.563	111	.474		
T	67.860	113			
a. Dependent Variable: Overall, AI and data analytics are critical for optimizing our SC processes.					
b. Predictors: (Constant), Data analytics tools have enhanced our ability to forecast customer demand accurately., The use of AI technologies has led to better inventory management in my organization.					

Table 4 Coefficients[a]						
		Unstd Coeff.		Std Coeff		
Model		B	SE	β	t	S
1	(Constant)	1.510	.462		3.267	.001
	The use of AI technologies has led to better inventory management in my organization.	.303	.101	.259	3.014	.003
	Data analytics tools have enhanced our ability to forecast customer demand accurately.	.329	.083	.340	3.957	.000
a. Dependent Variable: Overall, AI and data analytics are critical for optimizing our SC processes.						

The regression analysis reveals a moderate positive relationship between the independent variables and the dependent variable, with an R value of 0.475. The model explains about 22.5% of the variance in respondents' perceptions that AI/data analytics are critical for optimizing SC processes. The ANOVA results show that at least one predictor significantly contributes to explaining these variations, with an F-statistic of 16.152 ($p < .001$). Specifically, improvements in inventory management and demand forecasting accuracy are identified as significant predictors: for every unit increase in perceived improvement due to AI technologies in inventory management, there's an expected increase of about 0.303 units in overall perception ($p = .003$), while enhancements in demand forecasting accuracy lead to a stronger effect with an increase of approximately 0.329 units ($p < .001$). Overall, these findings suggest that both factors positively influence perceptions, but demand forecasting accuracy has a more substantial impact on how critical respondents perceive AI/data analytics to be for SC optimization.

Hence, **Hypothesis H1: AI and data analytics has a significant impact on the optimisation of SC** has been proved from the above analysis.

Hypothesis 2

H2: Challenges of AI implementation are prevalent in the retail sector

$H2_0$: Challenges of AI implementation are not prevalent in the retail sector

One sample t-test

Table 5 One-Sample Test						
	Test Value = 0					
					95% CI	
	t	df	S	MD	L	U
The cost of implementing AI-driven solutions is a significant barrier for my organization.	55.653	113	.000	3.982	3.84	4.12
I face challenges related to data privacy and security when adopting AI technologies.	55.883	113	.000	4.000	3.86	4.14
Resistance to change within the organization hinders the adoption of AI in our SC.	55.897	113	.000	3.807	3.67	3.94
Integration with existing systems poses a major challenge in adopting AI technologies.	50.768	113	.000	3.974	3.82	4.13

The one-sample t-test results indicate that respondents' perceptions about challenges in AI implementation significantly differ from zero, suggesting these issues are prevalent. For the cost barrier, the mean score of 3.982 (95% CI: 3.84, 4.12) shows strong agreement among respondents that it's a significant challenge ($p < .001$). Similarly, data privacy and security concerns have a mean score of 4.000 (95% CI: 3.86, 4.14), indicating widespread concern about these issues during AI adoption ($p < .001$). Resistance to change (Item20) also poses a significant hindrance with a mean score of 3.807 (95% CI: 3.67, 3.94; $p < .001$), while integration with

existing systems is another major challenge with a mean score of 3.974 (95% CI: 3.82, 4.13; $p < .001$). Overall, these findings highlight that all four types of challenges are perceived as substantial by respondents in the retail sector's AI adoption efforts.

Hence, **H2: Challenges of AI implementation are prevalent in the retail sector** have been proved from the above analysis.

Hypothesis 3

H3: There is a significant correlation between efficiencies metric of the SC and consumer loyalty

$H3_0$: There is no significant correlation between efficiencies metric of the SC and consumer loyalty

Bivariate correlation

The correlation test determines if a numerically significant linear and strong association exists among two considered continuous variables (Nelson, Christopher, & Milton, 2022).

Table 6 Correlations

		Improved SC efficiency has led to increased customer loyalty in my retail store.	Customers are more likely to return to my store due to reliable product availability.	Our ability to fulfil orders accurately enhances customer trust and loyalty.	There is a direct link between our SC performance metrics and repeat purchases from customers.
Improved SC efficiency has led to increased customer loyalty in my retail store.	PC	1	.403**	.349**	.374**
	S		.000	.000	.000
	N	114	114	114	114
Customers are more likely to return to my store due to reliable product availability.	PC	.403**	1	.358**	.256**
	S	.000		.000	.006
	N	114	114	114	114
Our ability to fulfil orders accurately enhances customer trust and loyalty.	PC	.349**	.358**	1	.248**
	S	.000	.000		.008
	N	114	114	114	114
There is a direct link between our SC performance metrics and repeat purchases from customers	PC	.374**	.256**	.248**	1
	S	.000	.006	.008	
	N	114	114	114	114

The correlation analysis strongly supports hypothesis by revealing significant positive correlations between various aspects of SC efficiency and consumer loyalty metrics. Improved efficiency correlates moderately with increased customer loyalty ($r = 0.403$; $p < .001$). Reliable product availability also shows a strong link to higher return rates among customers ($r = 0.403$; $p < .001$). Furthermore, accurate order fulfillment enhances trust/loyalty significantly ($r = 0.349$; $p < .001$), while better overall performance metrics correlate positively with repeat purchases from customers ($r = 0.374$; $p < .001$). These findings collectively indicate that optimizing SC operations leads to enhanced consumer loyalty.

Hence, **H3: There is a significant correlation between efficiencies metric of the SC and consumer loyalty** has been proved from the above analysis

Hypothesis 4

H4: AI driven SC has significant impact on the consumer satisfaction

$H4_0$: AI driven SC do not have significant impact on the consumer satisfaction

Table 7 Descriptive Statistics					
	N	Min	Max	M	SD
AI-driven efficiencies have significantly improved our customers' overall shopping experience.	114	1	5	3.93	.870
Faster delivery times due to AI optimizations have increased customer satisfaction.	114	1	5	3.93	.773
Our customers appreciate the accuracy of order fulfilment enabled by AI technologies.	114	2	5	3.81	.677
Enhanced product availability through AI has positively impacted customer satisfaction levels.	114	2	5	3.98	.716
Overall, AI-driven improvements in our SC have led to higher levels of customer satisfaction.	114	1	5	4.01	.867
Valid N (listwise)	114				

The descriptive statistics indicate that respondents generally perceive AI-driven SC efficiencies as positively impacting customer satisfaction. The mean scores for items related to overall shopping experience, faster delivery times, and enhanced product availability are all above 3.9, suggesting agreement among respondents about these benefits. Specifically, the mean score for overall impact on customer satisfaction is the highest at 4.01, indicating strong agreement that AI-driven improvements lead to higher levels of customer satisfaction overall. While order fulfillment accuracy shows a slightly lower mean score of 3.81, it still reflects a positive perception of AI's role in enhancing accuracy and thus contributing to better customer experiences.

Hence, **H4: AI driven SC has significant impact on the consumer satisfaction** has been proved from the above analysis.

Thematic Analysis

Sustainability integrated into framework for improving back-end SC operations

Table 8 Sustainability framework

Responses	Codes	Themes
AI aids in the transportation routes reduces carbon emission	[C1]	Energy efficiency
Energy efficient warehousing	[C2]	Infrastructure
Minimization of waste and excess stock	[C3]	Waste management
Circular economy	[C4]	Reuse
Recycling	[C5]	Reprocessing
IoT sensors for reducing energy utilization	[C6]	IoT sensors
Transparency through Block chain	[C7]	Compliance
NGO partnership elevates environmental performance	[C8]	Collaboration

There are several strategies for incorporating sustainability into SC operations that have been identified in the identified themes. Energy Efficiency is the use of AI in optimizing transportation routes, reducing carbon footprint and improving environmental sustainability. The focus on energy-efficient warehousing practices in infrastructure is intended to reduce operational costs and promote environmentally friendly operations. By optimizing inventory systems, Waste Management strives to minimize waste and excess stock while reducing costs and environmental impact. Reuse (circular economy) and Reprocessing (recycling) are two themes that aim to reduce raw material consumption by reusing or recycling materials instead of discarding them. In addition, IoT Sensors enable more accurate monitoring of resource usage to

improve operational efficiency and reduce unnecessary consumption. Blockchain technology provides a means by which SC transparency is ensured, and the theme of Compliance helps to guarantee regulatory compliance. In conclusion, collaborating with NGOs under the umbrella of Collaboration can improve environmental outcomes by harmonizing business practices with wider sustainability themes.

5. Discussion

The current study's outcome represents the impact of data analytics SC operation on the consumer experience in the retail industry. AI delivered numerous benefits to retailers which illustrated the significance of implementing AI in the retail sector. AI enables us to forecast consumer demands precisely. Cost barriers, data privacy, security and workers concern are the major challenges of integrating AI in the retail industry of digital world. Customers are influenced due to retailer strategies and approach which are enhanced because of AI implementation of SC operations in the retail business. The thematic and statistical analysis test demonstrates the beneficiaries of adopting AI in SC operations of retail sector.

The prevailing research (Adapa, 2024) examine the impact of AI-driven demand forecasting on SC optimization in the retail sector. The finding reveals that notable increase in forecasting accuracy, inventory management, and order fulfillment rates. The present study illustrates the significance of AI in SC operations of retail through regression analysis. The impact of data analytics on the SC optimization were analyzed and found to have significant association.

The existing study (Weber & Schütte, 2019) demonstrates the AI advantages in the industry. The value included core operations of retail organization are examined to find the possible usage and the adoption in market. The outcome showed there are various ranges to use AI such as marketing and replenishment with advantage of predicting upcoming events. Similarly, the present study discussed the benefits of AI in SC along with vulnerabilities of AI which makes adoption of AI in SC to retailer and consumer in a context of acceptance.

5.1 Limitations of the study

The self-reported information of retailers is used to supplement the study, which could be influenced by biases related to social desirability. Additionally, the research concentrates on the impact of AI-driven SC efficiencies on customer experience, while also disregarding other important factors such as pricing strategies, marketing campaigns, and competitive offerings. The study is confined to a particular timeframe, and the interplay between AI technologies and consumer habits could alter the long-term reliability of the outcomes. Despite being conducted across various retail sub-sectors and geographical regions, the findings may not be universally accepted due to the limited scope of the study.

6. Conclusion

The present research study examines the role of AI in retail SCs, identifies issues, evaluates whether efficiency and loyalty are related, determines the impact of AI on customer satisfaction, and suggests ways to improve. The outcome show AI has a strong positive impact on SC optimization by improving efficiency and saving costs, but adoption challenges also include cost barriers, integration issues, data privacy and resistance to change. However, efforts on SCs, such as product availability, order fulfilment, faster deliveries, were found to be strongly associated with increased consumer choice. Also, the improvements in AI-driven SC optimization greatly improved customer personalization and seamless experience. Retailers can make practical investments in AI by focusing on data integration, employee training and customer-centric backend enhancements. The study recommends future research should expand sample sizes, use longitudinal studies and also explore emerging technologies like blockchain and the demographic differences to deliver tailored endorsements for specific retail scenarios. Eventually, it will improve customer experience and sustainable performance.

References

[1] Adapa, S. R. (2024). Optimizing Supply Chain Efficiency Through Ai-Driven Demand Forecasting: An Empirical Analysis of Retail Industries. Library of Progress-Library Science, Information Technology & Computer, 44(3).

[2] Akturk, M. S., Mallipeddi, R. R., & Jia, X. (2022). Estimating impacts of logistics processes on online customer ratings: Consequences of providing technology-enabled order tracking data to customers. Journal of Operations Management, 68(6-7), 775-811.

[3] Alita, D., Putra, A. D., & Darwis, D. (2021). Analysis of classic assumption test and multiple linear regression coefficient test for employee structural office recommendation. IJCCS (Indonesian Journal of Computing and Cybernetics Systems), 15(3), 295-306.

[4] Anica-Popa, I., Anica-Popa, L., Rădulescu, C., & Vrîncianu, M. (2021). The integration of artificial intelligence in retail: benefits, challenges and a dedicated conceptual framework. Amfiteatru Economic, 23(56), 120-136.

[5] Babin, B. J., Feng, C., & Borges, A. (2021). As the wheel turns toward the future of retailing. Journal of Marketing Theory and Practice, 29(1), 78-91.

[6] Bansal, K. (2023). Customer experience: Creating value through transforming customer journeys. International Journal of Advances in Engineering and Management (IJAEM), 5(9), 715-725.

[7] Baur, N. (2019). Linearity vs. circularity? On some common misconceptions on the differences in the research process in qualitative and quantitative research. Paper presented at the Frontiers in Education.

[8] Bhagat, R., Chauhan, V., & Bhagat, P. (2023). Investigating the impact of artificial intelligence on consumer's purchase intention in e-retailing. foresight, 25(2), 249-263.

[9] Brau, R. I., Sanders, N. R., Aloysius, J., & Williams, D. (2024). Utilizing people, analytics, and AI for decision making in the digitalized retail supply chain. Journal of Business Logistics, 45(1), e12355.

[10] Cao, L. (2021). Artificial intelligence in retail: applications and value creation logics. International Journal of Retail & Distribution Management, 49(7), 958-976.

[11] Darboe, B. (2022). Towards excellent customer experience in e-commerce-Investigating the e-commerce journey from customer perspective.

[12] Du, S., & Xie, C. (2021). Paradoxes of artificial intelligence in consumer markets: Ethical challenges and opportunities. Journal of Business Research, 129, 961-974.

[13] Dzwigol, H. (2020). Innovation in marketing research: quantitative and qualitative analysis.

[14] Fu, H.-P., Chang, T.-H., Lin, S.-W., Teng, Y.-H., & Huang, Y.-Z. (2023). Evaluation and adoption of artificial intelligence in the retail industry. International Journal of Retail & Distribution Management, 51(6), 773-790.

[15] Gauri, D. K., Jindal, R. P., Ratchford, B., Fox, E., Bhatnagar, A., Pandey, A., . . . Howerton, E. (2021). Evolution of retail formats: Past, present, and future. Journal of Retailing, 97(1), 42-61.

[16] Goswami, S. S., Mondal, S., Sarkar, S., Gupta, K. K., Sahoo, S. K., & Halder, R. (2025). Artificial Intelligence-Enabled Supply Chain Management: Unlocking New Opportunities and

Challenges. Paper presented at the Artificial Intelligence and Applications.

[17] Grewal, D., Gauri, D. K., Roggeveen, A. L., & Sethuraman, R. (2021). Strategizing retailing in the new technology era. Journal of Retailing, 97(1), 6-12.

[18] Helo, P., & Hao, Y. (2022). Artificial intelligence in operations management and supply chain management: An exploratory case study. Production Planning & Control, 33(16), 1573-1590.

[19] Ishfaq, R., Davis-Sramek, B., & Gibson, B. (2022). Digital supply chains in omnichannel retail: A conceptual framework. Journal of Business Logistics, 43(2), 169-188.

[20] Jean, G. (2024). Inventory Management Strategies: Balancing Cost, Efficiency, and Customer Satisfaction.

[21] Jung, Y. M. (2019). Data analysis in quantitative research.

[22] Lakens, D. (2022). Sample size justification. Collabra: Psychology, 8(1), 33267.

[23] Mohajan, H. K. (2020). Quantitative research: A successful investigation in natural and social sciences. Journal of Economic Development, Environment and People, 9(4), 50-79.

[24] Mondol, E. P. (2021). The impact of block chain and smart inventory system on supply chain performance at retail industry. International Journal of Computations, Information and Manufacturing (IJCIM), 1(1).

[25] Nelson, K., Christopher, F., & Milton, N. (2022). Teach yourself SPSS and STATA. International Journal of Academic Pedagogical Research, 7(6), 84-122.

[26] Nurhilalia, N., & Saleh, Y. (2024). The Impact of Consumer Behavior on Consumer Loyalty. Golden Ratio of Mapping Idea and Literature Format, 4(2), 140-153.

[27] Oosthuizen, K., Botha, E., Robertson, J., & Montecchi, M. (2021). Artificial intelligence in retail: The AI-enabled value chain. Australasian Marketing Journal, 29(3), 264-273.

[28] Pal, A. (2024). Enhancing Customer Experience: Creating New Touchpoints for Experience-Centric Mobile Services.

[29] Patil, D. (2024). Artificial Intelligence In Retail And E-Commerce: Enhancing Customer Experience Through Personalization, Predictive Analytics, And Real-Time Engagement. Predictive Analytics, And Real-Time Engagement (November 26, 2024).

[30] Ratchford, B., Soysal, G., Zentner, A., & Gauri, D. K. (2022). Online and offline retailing: What we know and directions for future research. Journal of Retailing, 98(1), 152-177.

[31] Rusnaini, S., Ariyanto, M., Jessika, S., Pratiwi, W., & Marlina, E. (2024). The Customer Experience Revolution: Building Brand Loyalty in the Age of Digital Disruption. Enigma in Economics, 2(1), 69-80.

[32] Sagar, S. (2024). The Impact Of Digital Transformation On Retail Management And Consumer Behavior. Journal of Business and Management, 26(1), 06-14.

[33] Sallam, K., Mohamed, M., & Mohamed, A. W. (2023). Internet of Things (IoT) in supply chain management: challenges, opportunities, and best practices. Sustainable machine intelligence journal, 2, (3): 1-32.

[34] Sreekumar, D. (2023). What is Quantitative Research? Definition, Methods, Types, and Examples. Retrieved from https://researcher.life/blog/article/what-is-quantitative-research-types-and-examples/#What_is_quantitative_research12

[35] Stratton, S. J. (2021). Population research: convenience sampling strategies. Prehospital and disaster Medicine, 36(4), 373-374.

[36] Sürücü, L., & MASLAKÇI, A. (2020). Validity and reliability in quantitative research. Business & Management Studies: An International Journal, 8(3), 2694-2726.

[37] Taherdoost, H. (2021). Data collection methods and tools for research; a step-by-step guide to choose data collection technique for academic and business research projects. International Journal of Academic Research in Management (IJARM), 10(1), 10-38.

[38] Weber, F. D., & Schütte, R. (2019). State-of-the-art and adoption of artificial intelligence in retailing. *Digital Policy, Regulation and Governance, 21*(3), 264-279.

[39] Zhang, D. (2024). AI integration in supply chain and operations management: Enhancing efficiency and resilience. *Applied and Computational Engineering, 90*, 8-13.

[40] Zhang, Y. (2024). The Evolution of Loyalty Programs in the Digital Age: A Review of Consumer Engagement and Retention Strategies. *Business, Marketing, and Finance Open, 1*(2), 1-12.