M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)

(AFFILIATED TO THE UNIVERSITY OF MADRAS AND RE-ACCREDTED AT 'A++' GRADE BY NAAC)

CHENNAI - 600 034

DEPARTMENT OF COMMERCE

B.COM ACCOUNTING AND FINANCE SHIFT II

LUMIÈRE

(2024-2025)

EDITION : FIRST

"Quick Commerce - Navigating Towards the Future of Q - Commerce"

LUMIÈRE

2024 – 2025

DEPARTMENT OF COMMERCE

B.COM ACCOUNTING AND FINANCE (SHIFT – II)

QUICK COMMERCE

Navigating Towards the Future Of Q-Commerce

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ABOUT LUMIÈRE

Lumière is theme-based and presents the proceedings of selected student research papers prepared and presented during the academic year. Lumière provides a platform for students to explore contemporary issues in commerce and finance through structured academic writing and guided research.

By fostering a research-oriented learning environment, It seeks to encourage intellectual curiosity, promote academic discipline, and enhance students' exposure to basic research practices. Lumière reflects the department's commitment to strengthening academic culture and supporting students in their preparation for higher education and professional development. The academic year 2024–2025 marks a decade of Lumière, and in commemoration of this milestone, the department has taken the initiative to publish it as an ISBN-registered academic publication.

ABOUT THE PAPER PRESENTATION

The papers featured in Lumière were presented by students of B.Com Accounting and Finance (Shift II) through an online paper presentation webinar conducted via Google Meet. The initiative encouraged students to prepare original research papers aligned with the theme and present their findings in a formal academic setting.

The presentations were reviewed by a panel of academicians, and selected papers were refined and compiled for publication. This process helped students strengthen their research, presentation, and academic writing skills while gaining exposure to structured scholarly practices.

THEME FOR THIS YEAR'S PAPER PRESENTATION

The central theme for Lumière 2024–25 is "Quick Commerce – Navigating Towards the Future of Q-Commerce." The theme focuses on the rapid growth of quick commerce and its influence on consumer behaviour, business practices, and emerging market trends. With the increasing emphasis on speed, convenience, and instant fulfilment, quick commerce has reshaped traditional retail models through digital platforms, efficient logistics, and technology-enabled decision-making.

To encourage focused discussion and systematic exploration of the theme, the paper presentation webinar was organised into three thematic sessions, each addressing a distinct dimension of the quick commerce ecosystem.

Session I: Consumer Behaviour and Innovation in Quick Commerce

This session focused on the changing behaviour of consumers in the quick commerce ecosystem and the role of innovation in shaping purchasing decisions. Papers presented under this session examined digital payment systems, technological advancements, and evolving consumer expectations in the context of Q-commerce.

Session II: Business Models and Logistics in Quick Commerce

This session examined the operational aspects of quick commerce, including emerging business models, supply chain structures, and last-mile delivery mechanisms. The papers highlighted how logistics efficiency, inventory management, and technology integration support the sustainability and scalability of quick commerce platforms.

Session III: Trends in Cross-Border Trade

This session explored emerging trends in cross-border trade with reference to global markets and digital commerce. Papers under this session analysed international trade dynamics, regulatory considerations, and the challenges and opportunities faced by businesses operating across borders in a rapidly evolving commercial environment.

Collectively, these sessions provided students with a structured framework to analyse quick commerce from consumer, operational, and global trade perspectives.

The papers were presented and evaluated by a distinguished panel of academicians. They were:

1. **Dr. Akhil P,** Assistant Professor, Department of Commerce, CHRIST (Deemed to be University), Bengaluru.
2. **Dr. Ragetha Thankappan,** Assistant Professor, Department of Commerce, Ethiraj College for Women, Chennai.
3. **Dr. Suganya Sampat,** Assistant Professor, MCC Boyd Tandon School of Business, Chennai.

PROFILE OF THE PANEL OF ACADEMICIANS

Dr. Akhil P

Dr. Akhil P is Assistant Professor in the Department of Commerce at CHRIST (Deemed to be University), Bengaluru. He teaches undergraduate and postgraduate students and specializes in research methodology, data analysis, and finance. Dr. Akhil has contributed through research publications, academic workshops, and faculty development programs, and is known for promoting analytical thinking, research competence, and a learner-centric approach.

Dr. Ragetha Thankappan

Dr. Ragetha Thankappan is an Assistant Professor in the Department of Commerce at Ethiraj College for Women. She is actively engaged in teaching, academic administration, and student development. With experience in entrepreneurship and competitive exam guidance, Dr. Ragetha combines academic leadership with practical insights to foster holistic growth and academic excellence among students.

Dr. Suganya Sampat

Dr. Suganya Sampat is an Assistant Professor at MCC Boyd Tandon School of Business. She specializes in finance, analytics, and business systems, integrating theory with industry experience to enhance student learning. Dr. Suganya contributes to curriculum development, research, and mentoring, equipping students with critical thinking, problem-solving skills, and professional readiness.

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SESSION I

CONSUMER BEHAVIOUR AND INNOVATION IN QUICK COMMERCE

FROM CASH TO CLICKS: THE PROGRESSION OF DIGITAL PAYMENT SYSTEMS FOR INSTANT GRATIFICATION

Dyuti Srinivasan, Pooja L, Shreya Swaminathan

ABSTRACT

The advent of digital payment systems, particularly Unified Payments Interface (UPI), has significantly reshaped consumer behaviour in an era defined by instant gratification. In the quick commerce (Q-commerce) sector, the demand for speed and convenience has redefined how consumers approach purchases, with immediacy and seamless transactions now at the forefront of decision-making. The study seeks to explore the connection between instant payment solutions and consumer preferences, analysing their impact on spending behaviours and overall satisfaction. It identifies pivotal drivers of impulsive buying, including the simplicity of digital transactions, and the growing shift toward convenience-oriented consumption. At the same time, it sheds light on the psychological triggers behind overspending, emphasizing the critical need for balancing consumer gratification with financial discipline.

Through primary data analysis, the research provides actionable insights for businesses to refine payment systems, mitigate overspending tendencies, and promote responsible financial behaviour. This paper offers a roadmap for leveraging digital payment innovations to foster sustainable engagement in a gratification-oriented Q-commerce landscape while addressing the challenges of evolving consumer needs.

KEYWORDS:

UPI, instant gratification, quick commerce, consumer behaviour, Impulse buying decisions

INTRODUCTION

Since the introduction of the Unified Payments Interface (UPI) in 2016, India has received international recognition for the pace of transformation in its digital payment space. Being an efficient, seamless, and instant transaction method, UPI has not only replaced traditional banking methods but has also raised the benchmark for financial transactions. Alongside this, the rapid growth of Q-commerce is changing consumer expectations by providing ultra-fast delivery. The integration of UPI with such platforms creates a unified ecosystem that caters to the growing demand for immediacy both in payment and services.

Although encouraging ease and convenience, these trends are also a cause of alarm for financial discipline in people, as they often overspend due to the frictionless nature of digital transactions. This calls for the understanding of the psychological and behavioural impact of UPI on consumer behaviour. While existing literature highlight the rising adoption of UPI among Gen Z and millennials, they often overlook critical issues such as overspending and security concerns, which is one of the many gaps our paper aims to address. The hypothesis of this study is that UPI adoption significantly impacts impulsive buying behaviour, particularly in the Q-commerce sector, due to the convenience and immediacy of digital transactions. Moreover, younger consumers (aged 18-35) are more likely to adopt UPI for Q-commerce than their older counterparts. These hypotheses frame the research, underlining the psychological and behavioural shifts brought about by UPI and their implications on consumer financial habits. This research explores the dynamics of the interplay between UPI and Q-commerce while laying out concerns regarding financial discipline and

impulsivity. By analysing the generational and economic influences and barriers, the study seeks to provide actionable insights to optimize the digital payment system for creating an optimum balance of convenience with long-term financial well-being.

REVIEW OF LITERATURE:

Jyothi and Verma (2014) have explained instant gratification is the term used to describe the immediate pleasure experienced after fulfilling an acute demand without considering the long-term consequences. Impulsive buying is the tendency to make purchases without prior forethought. It occurs when consumers browse any kind of good or service and give in to the impulse to buy it without giving it any thought. Whether or not that product is necessary. Impulsive purchasing and consumer personality are closely related. People who exhibit emotional instability-characterized by traits such as worry, moodiness, and self-doubt; are more likely to act on impulse. This emotional inconsistent conduct is commonly known as 'neuroticism' and research indicates that it positively correlates with impulsive purchasing. Individuals who have a strong propensity for making impulsive purchases are especially vulnerable to the persuasive power of marketing techniques like pictures, commercials, and gifts, which may stimulate their curiosity and result in impulsive purchases.

According to **Rupesh Rupak (2024),** Unified Payments Interface (UPI) has revolutionized digital payments in India since its introduction by NPCI in 2016, offering seamless, real-time transactions. Its adoption surged due to factors like ease of use, zero transaction costs, and widespread acceptance, outpacing wallets and cards. Studies highlight its role in India's push toward a cashless economy, with a 147% growth in transaction volume over five years, reaching $227 billion in February 2024. The market, however, is highly concentrated, with PhonePe, Google Pay, and Paytm Payments Bank commanding over 95% of transaction volume and value. While PhonePe leads with a 48% share, concerns about monopolistic behaviour, barriers to entry for new players, and stagnation in innovation have been raised. Research proves UPI's transformative impact but warns of challenges such as cybersecurity risks, dependency on a few players, and the need for sustained competition to drive innovation and consumer welfare.

According to **Yi Yong Lee (2022),** Online impulse buying is characterized by spontaneous and unreflective purchasing decisions, often triggered by external stimuli in a shopping environment. The rise of online shopping platforms facilitates 24/7 access to purchases, which can intensify impulsive buying behaviours, particularly through cashless payment methods like E-wallets that create a perception of reduced financial impact. The Stimulus-Organism-Response (SOR) theory posits that external stimulus influence consumers' cognitive and emotional states, leading to impulsive buying responses. Key stimuli include perceived interactivity- which enhances user engagement and visual appeal, which enhances emotional experiences. Both factors positively impact perceived enjoyment, a critical driver of impulse buying. Research indicates that users experiencing high enjoyment levels are more likely to make impulsive purchases through E-wallets. Thus, understanding how mobile payment app characteristics influence perceived enjoyment can provide

insights into fostering impulse buying in digital shopping environments.

According to **Nair T (2024),** The concept of instant gratification is increasingly influencing consumer behaviour, particularly in India, where rapid technological advancements and mobile-first experiences shape purchasing decisions. Omnichannel commitment programs are vital for fostering customer loyalty among Gen Z consumers, who prioritize seamless and integrated shopping experiences. These programs enable customers to earn and redeem rewards across various platforms, whether in-store, online, or through mobile apps- creating a unified brand experience. Gen Z values convenience and expects flexibility, making it essential for brands to offer personalized experiences that leverage data analytics to tailor rewards to individual preferences. By embracing these strategies, brands can effectively capture the attention and loyalty of this influential generation in the competitive market landscape.

METHODOLOGY:

The research methodology methods used in this survey include primary data and secondary data. The primary sources used are a survey through a Google form: a questionnaire prepared to understand consumer behaviour towards instant payment systems, perceptions of security and convenience, and barriers while using such systems. The responses of 104 participants were systematically analysed and presented in b ar graphs and pie charts, giving a structured and comprehensive overview of consumer preferences and the challenges related to digital payment systems. The secondary data is sourced from published research papers, articles, and credible online platforms. This combination of data sources ensures a robust analysis, allowing for a deeper understanding of consumer behaviour in the dynamic environment.

RESULTS

Table 1: Demographic Profile

Profile	Description	Percentage
Gender	Male Female	42.3% 57.7%
Educational Status	Higher secondary/ Diploma Graduate Postgraduate Professional	31.3% 37.5% 21.9% 9.4%
Occupation	Student Employed Self employed Professional Home maker Retired	38.4% 32.9% 8.2% 8.2% 2.1% 10.3%
Age	18-32 33-44 45-60 61+	46.2% 31.7% 17.3% 4.8%
Monthly income	Rs. 0 - Rs. 25000 Rs. 25000 - Rs. Rs. 50000 Rs. 50000- Rs. 1,50,000 Rs. 1,50,000 and above	53.1% 15.6% 21.9% 9.4%

Demographic Overview:

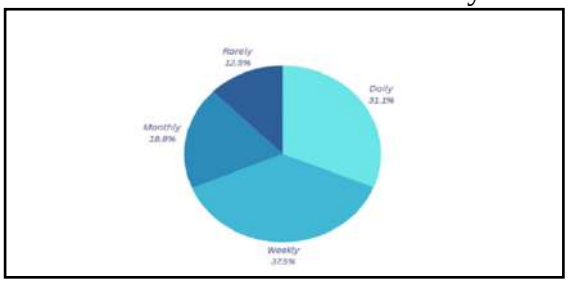
Over the course of the survey, responses from 104 participants were collected and analysed. The following are the objectives of the study that were derived from the questionnaire:

To analyse the Impact of Instant Payment Systems on Consumer Purchasing Behaviour. To evaluate Consumer Perceptions of Security and Convenience in Payment Systems. To examine barriers and discrepancies that respondents face and develop effective strategies to combat them.

Objective 1: - To analyse the Impact of Instant Payment Systems on Consumer Purchasing Behaviour

Frequency of online purchase

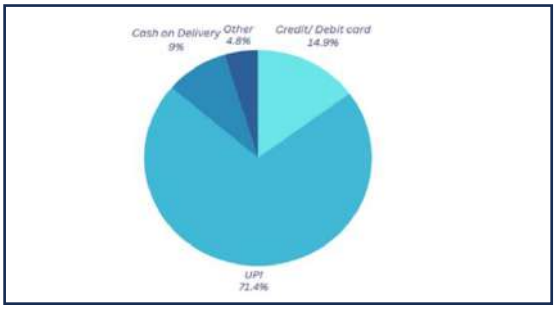
Chart 1: Taken from the survey



The above pie chart indicates a strong trend towards frequent online transactions. This suggests that consumers are increasingly integrating digital transactions into their shopping habits.

Method of payment for online transactions

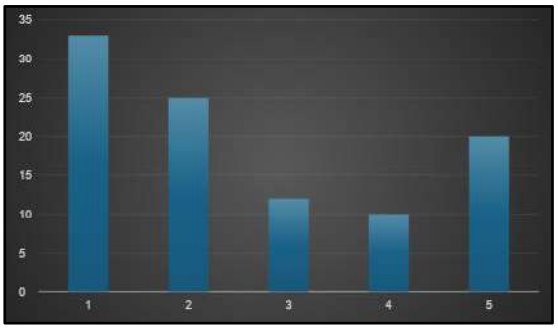
Chart 2: Taken from survey



71.4% of participants prefer using UPI as their primary payment method, highlighting its popularity among consumers. This preference reflects a shift towards instant payment solutions over traditional methods like credit/debit cards.

Instant payment solutions in enhancement of overall shopping experience.

Chart 3: Taken from survey

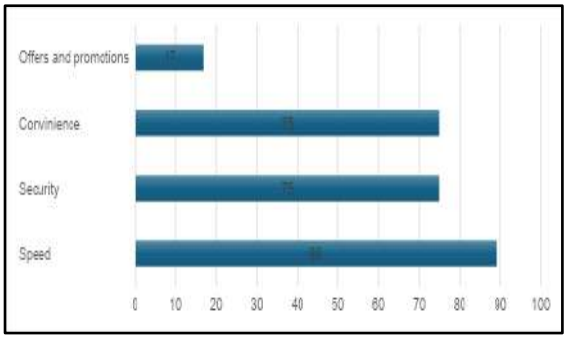


Most respondents rated their experience with instant payment solutions positively, with 33% selecting the highest rating of indicating a strong belief that these solutions significantly enhance their overall shopping experience.

Objective 2: - Evaluate Consumer Perceptions of Security, Speed and Convenience in Payment Systems

Factors influencing decision to use a specific payment method

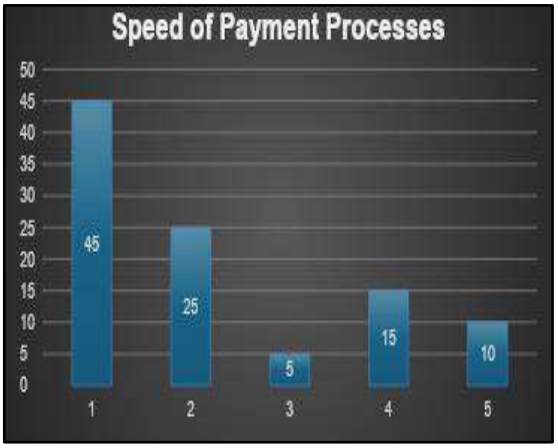
Chart 4: Taken from survey



The survey results indicate that **speed** is the most significant factor influencing payment method choice, with **89%** of respondents emphasizing its importance. **Convenience** and **security** follow closely at **75%** each. This demonstrates that consumers prioritize not just the efficiency of transactions but also the seamlessness of the payment process.

Importance of speed of payment processing when making a purchase

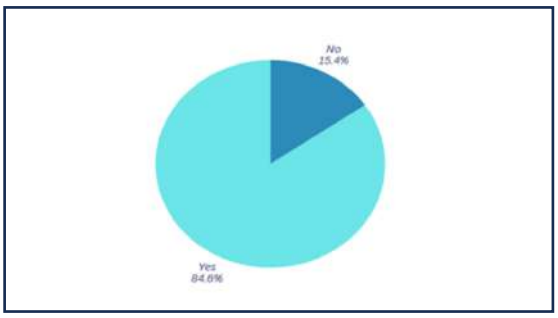
Chart 5: Taken from survey



A strong majority (45%) consider speed extremely crucial when making purchases, emphasizing the need for instant payment solutions to facilitate swift transactions.

Abandoned a purchase due to slow payment processing

Chart 6: Taken from survey

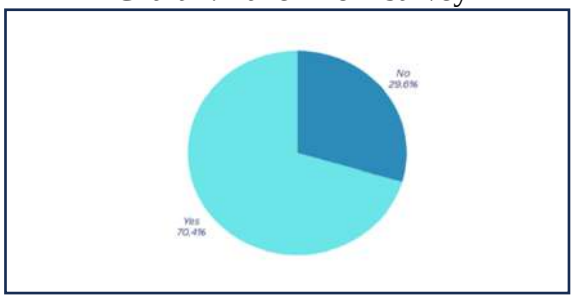


The fact that 84.6% have abandoned purchases due to slow processing emphasizes the importance of efficient transaction systems.

Objective 3: -To Examine Barriers and Discrepancies Faced and Develop Effective Strategies to Combat Them

Overspending when using UPI for transactions

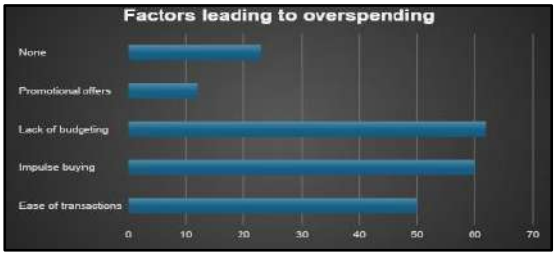
Chart 7: Taken from survey



More than 70% of the respondents have experienced overspending, indicating that instant payment solutions may lead to financial carelessness among users.

Factors that contribute to overspending when using these digital payment systems

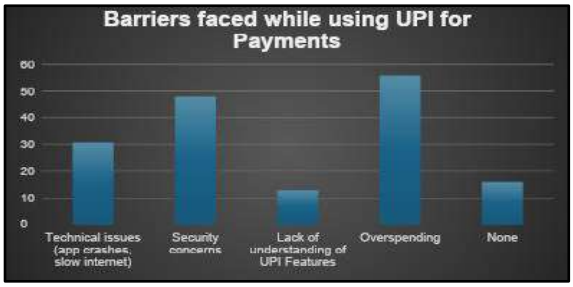
Chart 8: Taken from survey



The results revealed that **impulse buying (60%)** and **lack of budgeting (62%)** were the most significant reasons cited by respondents. In an era of *gratification and changing consumer preferences*, these factors highlight the challenges consumers face in managing their finances effectively. Additionally, **ease of transaction (50%)** was also noted as a contributing factor, further underscoring how the convenience of these payment solutions can lead to unplanned expenditures.

Barriers faced when using UPI for payments

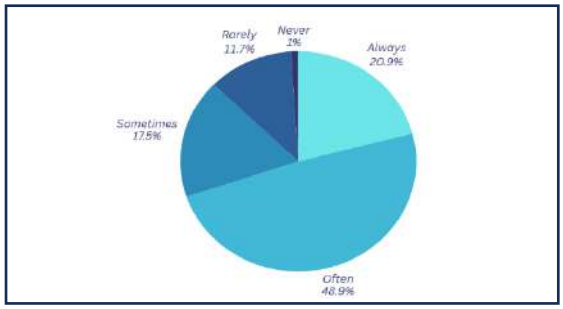
Chart 9: Taken from survey



Respondents voiced out security concerns (48%) and Overspending (56%) as the most significant barriers. Also, technical issues such as app crashes and slow internet were mentioned by 60% of users, meaning functionality is one of the most important aspects of a user's experience. Not knowing the features of UPI was cited by 40% of respondents as an area requiring better user education. Effective strategies to combat the same have been explored in the Discussion segment.

Need to monitor your spending after using UPI

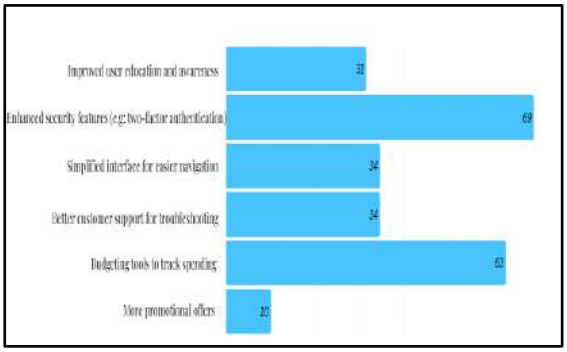
Chart 10: Taken from survey



The survey revealed that a significant portion of respondents reported feeling the need to monitor their spending after using UPI, with **48.9%** indicating they do so **often** and **21%** stating they do so **always**. This aligns with previous findings, suggesting that in the era of instant gratification, consumers tend to overspend.

Strategies to Combat these Barriers and discrepancies:

Chart 11: Taken from survey



When asked about effective strategies to combat barriers faced with UPI payments, respondents identified **enhanced security features** (69%) and **Budgeting tools to track spending (63%)** as critical solutions. **Simplified interfaces for easier navigation** and **better customer support for troubleshooting** (34%) were also emphasized. By incorporating the strategies effectively, UPI could enhance trust and UX, positioning itself as a global leader in the Q commerce sector.

DISCUSSION

The survey yielded significant insights into the evolving landscape of digital transactions in India. One of the major findings is the overwhelming preference for UPI among younger demographics, specifically individuals aged 18-32. This emphasizes the increasing reliance on mobile payment solutions among millennials and Gen Z, driven by their desire for convenience and instant gratification. Conversely, respondents aged 33-45 predominantly favoured traditional payment methods such as credit cards and net banking, highlighting a *generational divide in payment preferences*. This observation supports earlier research by Gupta and Arora (2020), which found that older consumers exhibit a reluctance to adopt newer payment technologies, often due to concerns regarding security and familiarity with existing methods.

Yet another aspect delved into is the understanding of how economic factors influence payment preferences. The survey revealed that individuals in lower income brackets are more likely to use UPI due to its cost-effectiveness and ease of access. This supports the work of Risca, Satria, Anisa (2021), who noted that UPI's lack of transaction fees makes it an attractive option for cost-sensitive consumers. Furthermore, higher income groups demonstrated a blend of payment methods, often using credit cards for larger transactions while utilizing UPI for smaller, day-to-day purchases. This finding suggests that financial literacy and awareness of benefits may play a crucial role in shaping payment behaviours, who emphasized the need for consumer education regarding digital payment options.

However, a critical concern identified in the survey is the tendency towards *overspending* associated with the convenience of UPI transactions. Many respondents reported that the ease of making instant payments often leads to impulsive purchasing decisions, thereby compromising their financial discipline. This aligns with the notion that while digital payment methods enhance accessibility, they can also contribute to a lack of budgetary planning and awareness of spending patterns. Consequently, it is

essential to address these issues by integrating budgeting tools within UPI applications, which could help consumers track their expenditures more effectively and mitigate the risk of overspending.

Moreover, the survey underscored the convenience and speed of UPI as key factors driving instant gratification among users. The ability to complete transactions within seconds has made UPI the preferred choice for quick purchases, further fuelling consumer expectations for immediacy in their buying experiences. To enhance user engagement and satisfaction, our research identified several strategies that could effectively address barriers associated with UPI payments. A significant percentage of respondents expressed a preference for enhanced security features, particularly two-factor authentication, which was favoured by 69% of respondents. The introduction of budgeting tools to track spending garnered support from 63% of respondents, reflecting a strong desire for tools that promote responsible financial management.

SOLUTIONS PROPOSED

In light of these findings, several strategies can be implemented to enhance the UPI experience and address consumer concerns effectively. First, enhancing security features remains paramount, as emphasized by the 69% of respondents who favoured **two factor authentication**. 2FA adds an additional layer of protection by requiring users to verify their identities through a secondary method, such as a one-time password or biometric scan, thereby significantly reducing the risk of fraud. By implementing biometric features like fingerprint or facial recognition, systems can significantly increase user confidence in UPI transactions, alleviating concerns about fraud and security breaches.

Simplifying the user interface to facilitate easier navigation is essential, as supported by the 55% of participants who expressed this preference. Streamlining the design can help users, especially those less tech-savvy, to navigate the app with ease, enhancing their overall satisfaction. The integration of **UPI AutoPay** allows users to automate recurring payments, promoting convenience and financial responsibility. Government initiatives like the Digital India campaign further enhance UPI adoption and digital literacy thus moving towards a Viksit Bharat.

Another pivotal strategy is the integration of a **Budgeting Assistant** within UPI applications, which has garnered substantial interest from 58% of respondents. This feature would empower users to set personalized spending limits, categorize their expenses, and receive real-time alerts when nearing their budget thresholds. By analysing transaction histories through advanced algorithms, the Budgeting Assistant could help set spending limits, categorize expenses, and receive alerts, ultimately encouraging better financial management and reducing impulsive purchases. Offering visual dashboards for tracking expenses and notifications for upcoming bills would further enhance user engagement and promote financial discipline.

CONCLUSION

In conclusion, this research highlights the significant shift in consumer payment preferences towards UPI in India, particularly among younger demographics who favour its convenience and speed, which fosters a culture of instant gratification in digital transactions. The findings reveal that while UPI's cost-effectiveness appeals to lower-income groups, there is a notable risk of

overspending due to its ease of use, necessitating the integration of budgeting tools within UPI applications to promote responsible financial management. The study emphasizes the importance of enhanced security features and user-friendly interfaces to improve consumer confidence and experience. These insights contribute to the existing body of knowledge on digital payment behaviours, confirming the hypothesis that consumer preferences are evolving alongside technological advancements and a growing desire for immediacy. Future research could further explore the long-term impacts of these payment trends on financial discipline and consumer habits. Overall, this study underscores the need for innovative solutions that not only facilitate transactions but also empower consumers to manage their finances effectively in an increasingly digital economy.

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IMPACT OF ECONOMIC AND MARKET TRENDS ON INVENTORY MANAGEMENT: A PREDICTIVE APPROACH

Akshaya S, Lakshmi S

ABSTRACT

Inventory management plays a critical role in the operational efficiency and profitability of businesses, involving the meticulous oversight of the product lifecycle—from sourcing raw materials to delivering finished goods. The primary goals are to optimize inventory levels, ensure customer satisfaction, and reduce supply chain risks. Effective inventory management strikes a delicate balance: maintaining adequate stock to meet consumer demand while minimizing excess inventory and operational inefficiencies.

Globalization has significantly expanded and complicated the Indian market, exposing businesses to a complex interplay of microeconomic and macroeconomic factors. Elements such as fluctuating consumer demand, inflation, GDP growth, and stock market volatility now hold greater sway over inventory strategies. This dynamic environment has made demand forecasting increasingly intricate, thus bringing in the importance of predictive decision-making.

With the rise of quick commerce—characterized by the rapid delivery of goods, often within minutes or hours—inventory management strategies have had to evolve. The study explores how quick commerce necessitates hyper-localized inventory systems, real-time stock updates, and agile supply chain models to meet instantaneous demand. By integrating predictive analytics, businesses can navigate the dual challenges of globalization and the swift demands of quick commerce effectively.

The study utilizes primary data sourced from government publications, economic surveys, and reputable websites to provide a robust and reliable foundation for analysis. By integrating statistical tools like regression and inventory management frameworks, this paper seeks to enhance strategic decision-making in inventory management in the context of rapidly changing market conditions. This research aims to analyse historical GDP trends in relation to demand and supply factors. The findings suggest that incorporating predictive analytics into inventory management allows businesses to anticipate market shifts effectively, optimize resource allocation, and maintain operational resilience.

KEYWORDS:

Inventory management, predictive decision-making, quick commerce, globalization impact, GDP trends, strategic planning.

INTRODUCTION

Globalization has significantly increased the complexity of analysing demand and supply. The interconnected global economy and rapid technological advancements have dramatically altered the relationships between economic factors, making accurate forecasting more challenging. This underscores the importance of our research in understanding the well-being of the agricultural and allied sectors.

Quick commerce, as a disruptive force, adds another layer of complexity. Businesses in sectors ranging from agriculture to retail are now pressed to adopt micro-fulfilment centres, dynamic inventory replenishment, and predictive analytics to meet real-time consumer expectations. Quick commerce thrives on speed and convenience, making inventory decisions crucial to avoid stockouts or overstocking. By integrating quick

commerce practices into predictive inventory models, businesses can better align their strategies with contemporary consumer behaviour.

Specifically, our research examines the relationship between Gross Capital Formation (GCF) and demand within agriculture and allied sectors. This includes fishing, poultry, agriculture, livestock, crops, and aquaculture. We developed a regression model that predicts demand and supply based on anticipated GCF, facilitating easier trend forecasting.

Our regression analysis revealed a concerning decline in GCF during the second quarter of 2024, after a period of sustained growth. This paper investigates the reasons behind this decline, forecasts future trends based on our model, and explores effective inventory management strategies for businesses to navigate these changing market conditions.

However, the regression model, while valuable for quantitative analysis, cannot capture the qualitative aspects of the factors influencing demand. This limitation constitutes a gap in our research, as a complete understanding of demand trends necessitates a more holistic approach that incorporates qualitative analysis.

LITERATURE REVIEW

Chopra, S., & Meindl, P. (2016) Discuss how globalization has disrupted traditional inventory systems and necessitated advanced supply chain strategies. Focus on how businesses are adjusting to dynamic global trade environments.

Srivastava, A. (2018) Analyse the specific challenges that globalization presents to Indian agriculture, such as increased competition and supply chain uncertainties.

Hyndman, R. J., & Athanasopoulos, G. (2021) Include how predictive analytics tools like ARIMA models have been used to enhance inventory management through better demand forecasting.

Singh, K., & Gupta, R. (2019) Incorporate case studies or examples from the article to illustrate the application of machine learning techniques in predicting inventory requirements.

Bhattacharya, R. (2017) Discuss the correlation between economic factors (like GDP and GCF) and their practical implications for inventory levels and decision-making in agriculture.

Kumar, A., & Das, P. (2020) Elaborate on the importance of combining qualitative and quantitative data to create a more nuanced understanding of inventory dynamics.

Ministry of Finance, Government of India (2023) Use the economic survey findings to substantiate the paper's discussion on recent trends in GCF and their impact on agriculture.

METHODOLOGY

Research design: As the main subject revolves around the comparison of GCF and demand supply trend of agriculture and allied sectors, Regression analysis can determine if changes in one or more independent variables are linked to changes in the dependent variable. could help in justifying the same. A statistical method for establishing a relationship between a dependent variable and one or more independent variables is regression. Regression analysis can determine if changes in one or more independent variables are linked to changes in the dependent variable.

Sample data adopted: The main source of

data was an economic survey by the source being the Indian government, the data are authentic and reliable story of Finance (first hand data) and trading economics. The source being the Indian government, the data are authentic and reliable.

Sample size: We have compared GCF and demand trends of agriculture and allied sectors for a period from 2016-17 till date.

Tools employed: MS Excel and Power BI were used to analyse data, supplemented by simulations modelling quick commerce inventory frameworks to examine their scalability and applicability in agriculture.

RESULTS

An in-depth analysis of demand and GCF of agriculture and allied sectors has led us to the following conclusion. The workings are in the table attached below:

Year	GCF of Agriculture & Allied Sector (Rs. In Crore) x	Demand y	x=X-E(X)	y=Y-E(Y)	xy	x sq	y sq
2016-17	267153	460000	-65442	-75285.71429	4926847714	4282655364	5667938776
2017-18	272321	497000	-60274	-38285.71429	2307633143	4282655364	1465795918
2018-19	272321	492000	-35964	-43285.71429	1556722429	1293409296	1873663061
2019-20	302808	535000	-29787	-43285.71429	8510571.429	887265369	816326531
2020-21	354001	553000	21406	17714.28571	379192000	458216836	313795918.4
2021-22	383608	583000	51013	47714.28571	2434048857	2602306369	2276653061
2022-23	451643	627000	119048	91714.28571	10918402286	14177426304	8411510204
Total	2331185	3747000	Nil	nil	22581362000	27329254414	20009428571

Mean X =332595

Mean Y=535285.7143

Bxy=1.126037254

Reg equation of X on Y:

x-332595=1.126(y-535285.7143)

Equation:

x=1.126y-270156.6557

The regression analysis indicates a positive correlation between the Gross Capital Formation (GCF) in the agriculture and allied sectors and the demand trends (INR billion) over the analysed period.

The regression equation derived, x = 1.126y - 270156.6557, demonstrates a strong linear relationship, with GCF increasing as the demand (INR Billion) rises.

Trends in GCF Over Time:

GCF has shown a consistent growth from ₹2,67,153 crores in 2016-17 to ₹4,51,643 crores in 2022-23. This increase reflects the growing investment in agriculture and allied sectors, likely spurred by government initiatives and economic growth.

The data unequivocally shows that the GCF has been steadily rising since 2016–17, with a sharp decline in the second quarter of 2024. According to the Ministry of Finance's economy study, the bad and delayed monsoon is the cause. Additionally, this suggests that the postponed monsoon may boost GCF in the third quarter, which would raise output.

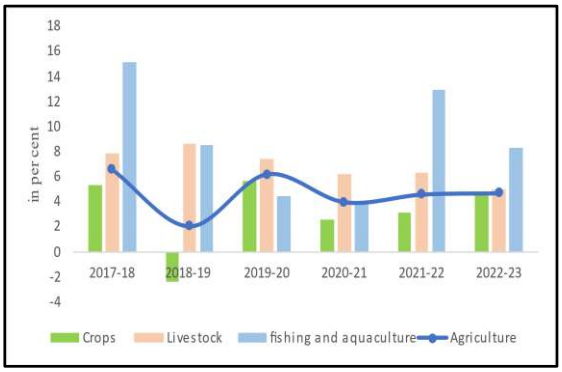
When incorporating quick commerce models, businesses can utilize predictive analytics to align hyperlocal inventory needs with fluctuating seasonal demands. For example, delayed monsoons in 2024 disrupted inventory cycles, but quick commerce hubs mitigated shortages through rapid replenishment frameworks.

Below is the table representing the share of sub sectors covered under agriculture and allied sector from the year 2016-17 to 2022-23.

Table Showing the Share of Sub Sectors Covered Under Agriculture and Allied Sector from The Year 2016-17 To 2022-23.

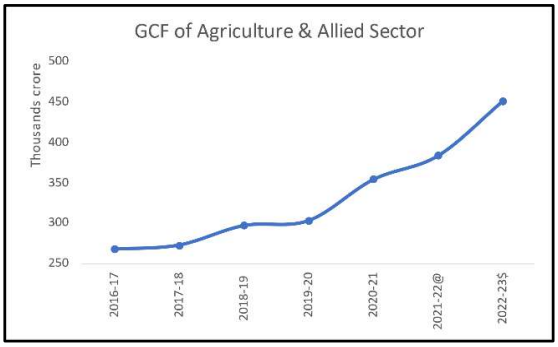
Years	Agriculture	Crops	Livestock	Fishing and Aquaculture
2017-18	6.6	5.4	7.9	15.2
2018-19	2.1	-2.4	8.7	8.5
2019-20	6.2	5.7	7.5	4.5
2020-21	4	2.6	6.2	3.8
2021-22	4.6	3.2	6.4	13
2022-23	4.7	4.7	5	8.3

Chart 1.1 Showing the Share of Sub Sectors Covered Under Agriculture and Allied Sector from The Year 2016-17 To 2022-23.



Despite India's position as a major agricultural producer, ranking second globally in rice, wheat, cotton, and leading in milk, pulses, and spices, its crop yields lag behind those of other major agricultural nations. This is particularly concerning given the substantial government support directed towards rice and wheat production. Factors contributing to these low yields include fragmented land holdings, insufficient investment in agriculture, limited farm mechanization, inadequate access to quality inputs and efficient marketing infrastructure, heavy reliance on rainfall, and short growing seasons.

Chart 1.2 Showing How Demand Moves Alongside GCF



The graph gives a clear picture of how demand moves alongside GCF. This shows GFC creates demand for goods and services through investment, which leads to the production of more goods and services. GCF can stimulate economic development by increasing productivity, which can lead to infrastructure development, innovation, and improved manufacturing.

DISCUSSION

Since the 2024 monsoon is delayed, let's assume that it will last longer in the third quarter, with a rise in GCF and proportionate demand.

Quick commerce, given its emphasis on immediacy, can compensate for monsoon-induced delays by leveraging localized inventory storage. This model ensures that businesses in agriculture can meet consumer needs despite climatic disruptions.

Since we majorly discuss agriculture and allied sectors we don’t discusses upon detailed specific areas like seasonal crops.

Interpretation:

The Indian GDP from agriculture (in trillions) has steadily increased from 4.6 in 2016-17 to 6.27 in 2022-23, showcasing rising demand in the sector. However, the percentage contribution of GCF to the GVA (Gross Value Added) of the agriculture sector has fluctuated, with significant growth observed in recent years, reaching 19.9% in 2022-23.

Recommendations that are to be adhered by companies to cope effectively with the changing trend are:

Adapt to Demand Fluctuations:

Given the forecasted higher demand in the 3rd quarter, companies should scale up production and operations in advance. They should prepare for potential demand surges by ensuring adequate inventory and resource availability. During the decline, companies can focus on optimizing operations, reducing costs, and maintaining flexibility to ramp up production quickly in response to the upcoming increase in demand.

Invest in Technology and Automation:
To maintain efficiency during both periods of growth and decline, companies should invest in technology and automation. This can help streamline processes, reduce human error, and improve scalability, particularly during high-demand periods.

Focus on Demand Forecasting:
Regular and accurate demand forecasting should be prioritized. Using predictive analytics and machine learning can improve accuracy in anticipating future demand and align production schedules and supply chain strategies accordingly.

Optimize Supply Chain Management:
Companies should enhance their supply chain resilience to cope with market fluctuations. This includes diversifying suppliers, increasing stockpiles during demand slumps, and building more responsive logistics networks for periods of high demand.

Cost Management Strategies:
During the decline, companies should focus on cost optimization, such as renegotiating supplier contracts or improving operational efficiency, to protect margins without sacrificing quality.
Implement lean management practices to minimize waste and ensure a more flexible response to market changes.

Regional Market Focus:
Companies should monitor regional demand trends and tailor their strategies to cater to areas showing higher demand. This may involve region-specific marketing or adjusting distribution strategies to match local consumption patterns.

Collaboration with Government and Industry Bodies:
Engaging with government initiatives and industry bodies can provide early insights into policy changes and sector-specific developments. This helps companies stay ahead of regulatory shifts that may impact demand trends or capital formation.

CONCLUSION

The findings of this study highlight the critical role of integrating predictive analytics into inventory management to address the challenges posed by fluctuating economic and market trends. The regression analysis reveals a positive correlation between Gross Capital Formation (GCF) and demand in agriculture and allied sectors, emphasizing that effective management strategies must adapt to both quantitative trends and qualitative insights.

Delayed monsoons in 2024 underscore the need for businesses to anticipate seasonal disruptions and mitigate their effects through proactive measures. Quick commerce models, with their emphasis on rapid fulfilment and localized inventory, offer a vital solution for mitigating such disruptions. By leveraging predictive analytics and real-time data, quick commerce enables businesses to align inventory with immediate demand and minimize delays caused by external factors like weather.
Companies can navigate these challenges effectively by:

Investing in technology: Leveraging advanced tools to streamline operations, enhance forecasting accuracy, and facilitate quick commerce operations.

Building resilient supply chains: Developing systems that integrate localized inventory hubs, enabling rapid responses to both demand surges and slumps.

Prioritizing cost optimization: Implementing strategies during low-demand periods that protect long-term growth while maintaining readiness for sudden increases in quick commerce

activity. By aligning inventory practices with macroeconomic trends and leveraging advanced tools such as machine learning and AI, businesses can enhance resource allocation, operational efficiency, and market responsiveness. Moreover, fostering partnerships with government and industry bodies can provide early access to critical policy shifts and market developments.

Adopting to the measures discussed in discussion companies of agriculture and allied sector can expect a good rise in shares of the sector. Expected increase in production in the third quarter will also add on to it. Overall, this research has given businesses the ability to identify future trends and examine the strategies, implement and successfully address the challenges posed by economic and market volatility.

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COMBATING COUNTERFEITING: STRENGTHENING IP PROTECTION FOR INDIAN BRANDS IN THE GLOBAL MARKET

Hansini V, Samiksha A

ABSTRACT

The globalization of markets has accentuated the need for brand protection efforts, especially among Indian firms who are experiencing several issues concerning the loss of Intellectual Property (IP). While globalization continues to gather pace, Indian-based companies are experiencing a heightened vulnerability to counterfeiting, infringement and dilution of IP in global territories, which has a severe impact on competitiveness in overseas markets. This research paper examines the current and future state of brand protection, advocating for strict regulatory and enforcement outcomes, with an emphasis on the legal, economic, and strategic considerations for securing IP.

This paper aims at reviewing the approaches used in various brands' protection while analysing the strengths and weaknesses of every nation's legal system to safeguard IP. This involves collection of data from relevant literature and pestle analysis of IPR of the country and Indians firms that have implemented brand protection strategies. Particular attention is paid to the correlation between domestic IP legislations, international treaties, and procedures for their protection. Thus, it has been ascertained that although legislation has evolved in India, enforcement continues to be a major concern for firms. The current enforcement appears to be weak due to high counterfeiting and poor collaboration among agencies that handle the enforcement. In addition, another facet of this problem is the inability of stakeholders to recognize these problems and, as a result, companies are not ready to face threats associated with IP. Therefore, the paper recommends the adoption of several strategies to increase the strength of IP laws and increase the capacity to enforce them, and raise awareness among the population and other stakeholders. Through the execution of these strategies, the Indian companies will be in a position to safeguard the genuineness of their brands, encourage innovation, and effectively compete in the international markets.

KEYWORDS:

Intellectual Property, Brand Protection, Counterfeiting, Globalization, National IPR Policy

INTRODUCTION

The modern global economy has placed unprecedented emphasis on the value of intellectual property. Intellectual property refers to the broad spectrum of intangible, non-physical goods from the human brain inventions, literary and artistic works, symbols, names, images, and designs used in commerce. The four categories of intellectual property protection include trade secrets, trademarks, copyrights, and patents. Along with encouraging an environment of creative production and economic development, these categories are designed to ensure the rights of writers and inventors to reap from them work (WIPO, 2024).

This is especially important in a world that is becoming increasingly globalized and whose markets are rapidly converging. Such companies face a myriad of intellectual property issues when expanding businesses to new territories. Among such problems is the counterfeit issue.

Counterfeits prolong the lives of a failing business, and at the same time pose a threat to genuine brands, thus hurting the economy at large. According to WIPO (2024), enforcing the right to IP drives

economic development, especially in broadband networks. Nothing could be starker than this for Indian brands to compete globally. Losing intellectual property can strangle innovation, shrink market share, erode consumer trust, and allow fraudulent goods to enter the market. Indian brands thus have to operate in a challenging environment where securing their IP is critical to sustaining their viability in foreign markets. Legal and strategic protection of Indian brands in foreign markets is required. Tata Group and Infosys are expanding their international presence, and their ideas and brand identities must be protected from unauthorized use. One of the measures the government of India has been taking for the development of its IP system is the National Intellectual Property Rights Policy, but these gaps in enforcement and public awareness persist.

This paper aims to critically analyse the status of Indian brand protection within the rapid context of commerce. The research paper will outline the various barriers Indian businesses are facing in the battle against counterfeiting by doing a PESTLE analysis. It will promote strategic actions directing to improve the efforts at protecting intellectual property while building brand prestige within a very competitive global market.

It also analyses current intellectual property regimes governing brand protection in India and gives useful suggestions to improve IPs' protections in rapid commerce. Through these initiations, this research will raise awareness among the stakeholders regarding the importance of intellectual property rights as well as promising a culture that appreciates innovation and brand integrity.

REVIEW OF LITERATURE

It remains a great challenge for Indian brands looking to enter the world market since, according to the OECD in 2018, India ranks sixth in the world in terms of counterfeit goods sources. The country is also known to be the largest exporter of fake pharmaceuticals.

The Indian government has also established initiatives like the National Intellectual Property Rights (IPR) Policy, aiming to enhance awareness of IP rights through Dedicated Intellectual Property Rights Cells in each state (Mondaq, 2021).

In addition, there are the Trademarks Act, Copyright Act, and Drugs and Cosmetics Act, all of which have been established to fight counterfeiting activities (GS1 India, n.d.).

The enforcement of these policies is challenging because of bureaucratic inefficiencies and limited resources (OECD, 2018).

Technological innovation is so crucial in fighting this war against counterfeiters. Amazon and Alibaba have developed high-tech methods of anti-counterfeiting technologies, relying on data analytics and artificial intelligence applied in their respective real-time detection of counterfeits (Mondaq, 2021).

Consumer awareness is also essential for reducing demand for counterfeit products (GS1 India, n.d.).

Even in these areas, legislative and technological measures are ongoing efforts towards better mechanisms in enforcement and consumer education. Counterfeiting has evolved from a minor offence to an economic issue that tests sectors such as pharmaceuticals and FMCGs (Logistics Insider, 2020).

While technology has been of help in the identification of counterfeiting and, thus, its prevention, it has also enabled counterfeiters to create sophisticated replicas (Kochar, 2024).

The COVID-19 pandemic also worsened things. The counterfeiting of PPE and sanitisers saw a steep rise, with criminal elements taking advantage of consumer vulnerability during health crises (Economic Times, 2020)

METHODOLOGY

The research methodology for this paper will be developed using the PESTLE analysis. This framework categorizes initiatives into six distinct groups: Political, Economic, Sociological, Technological, Legal, Environmental. It will also assist in identifying essential areas that have to be attended to achieve the best in research to avoid overemphasizing some areas at the expense of others.

The resources include scholarly databases, Google Scholar, Scopus, and Web of Science.

Keywords to be used will include "counterfeiting," "intellectual property protection," "Indian brands," and "global market."

Articles chosen must be in English, peer-reviewed, full-text accessible, and published within the last ten years. Articles that do not use English and those irrelevant to the research question are excluded. This process can be followed to identify any literature that has been made regarding the fight against counterfeiting and the promotion of intellectual property protection for Indian brands in the international market. Proactive measures such as conducting anti-counterfeiting raids and working in collaboration with law enforcement has been emphasised, and public awareness will be necessary to hold on to the brand's integrity.

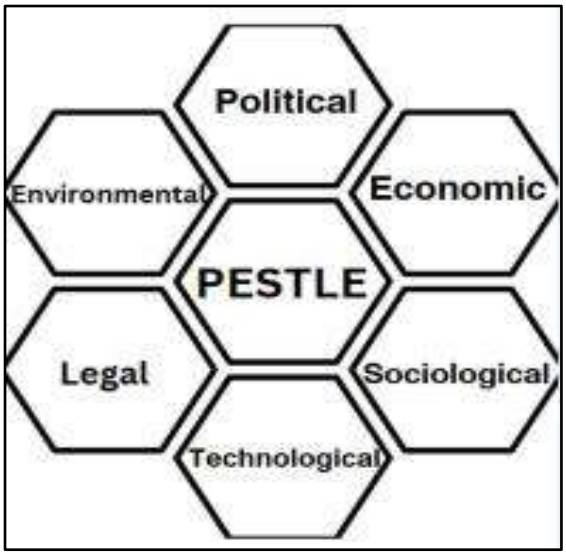

Fig 1

RESULTS AND DISCUSSION

This paper accentuates the challenges in the protection of Indian firm's intellectual property against the tide of globalization. It further highlights that although India boasts of a good IP legislative framework, it is considerably weakened by judicial procedures and weak inter-agency collaboration in its enforcement mechanism. It proposes legislative reforms to improve enforcement capabilities and recommends the use of international treaties to bolster brand protection strategies with an aim to enhance competitiveness for Indian companies in the global market.

Key findings of PESTLE Analysis

Political Factors

Many of the initiatives initiated by the government of India are against the issue of counterfeiting. Mainly, it includes the National Intellectual Property Rights (IPR) Policy and the "Make in India" campaign. They focus on building intellectual property laws and enforcing mechanisms in order to secure the internal brands. Among these steps is specialized IP enforcement units in

law enforcement agencies with the particular role of investigating and prosecuting IP crimes that reinforce the overall enforcement framework and ensure a safe business environment (Raj, 2022).

International commitments such as WTO and TRIPS have further indicated the Indian commitment to the protection of intellectual property. However, uneven application of the standards throughout the country has been reported by the EUIPO and OECD as areas requiring better enforcement and compliance (Raj, 2022). This lack of consistency may erode investor confidence, both nationally and internationally. Political stability also helps in proper enforcement because instability creates scope for counterfeiting due to the erosion of law enforcement capabilities. The "Make in India" initiative supports local production and raises public awareness of risks related to counterfeit products by building a culture that respects IP rights.

Economic factors

Counterfeiting has been an enormous loss to Indian brands in terms of lost sales and dilution of brands, where the loss stands at about ₹1 lakh crore or $12 billion annually. This is not only an issue for the companies individually but also a more macroeconomic one for the Indian economy because of lost jobs and lower tax revenues. Economic downturns may worsen counterfeiting as consumers seek cheaper alternatives during bad times, further hurting genuine brands. Advanced technologies like blockchain and AI can also be the future weapons in the war against counterfeiting. Although these require colossal investment initially, saving through minimised losses will pay in the long run. Indian pharma is also vulnerable because, in some sectors, 20% of market shares are covered by counterfeit medicines and pose extreme health risks due to getting the wrong drug.

Sociological Factors

Consumer behaviour is one reason counterfeit products are on the increase. Some consumers deliberately prefer lower-priced fakes. Most consumers are ignorant of the health and safety aspects of counterfeit products. Organized awareness campaigns should begin enlightening consumers regarding these dangers and influencing consumer behaviour.

Improvement in brand loyalty coupled with moral consumption promotion will also help in winning the war against counterfeiting. Attention-focused campaigns can stimulate consumers' morality about authentic brands. Some NGOs, for instance, "Think Before You Buy," educate the public and inform them of the dangers counterfeit goods pose, especially in fashion and electronics. So far, such initiatives may help change consumers' perspectives and encourage them to value authenticity in products and services rendered.

Technological factors

Advanced detection technologies are required to counter counterfeits. Blockchain develops an immutable log along the entire supply chain to ensure authenticity. Artificial intelligence will analyse consumer behaviour and pick up suspicious transactions, but SMEs cannot access this technology because of resource limitations. SMEs must, therefore, invest in anti-counterfeiting solutions to be at par with more prominent companies.

This requires innovations from authentic brands as they seek to protect their identities. For instance, VeChain employs blockchain technology to effectively trace luxury goods from manufacturer to sell,

which is why fewer incidences of counterfeiting are recorded in high-value markets.

Legal Factors

India has a whole suite of international intellectual property laws that are international standards but lags in their enforcement or public awareness (Vajiram & Ravi, 2024). Whether the legal or constitutional provisions like the Trademark Act or Copyright Act-long processes in courts usually weaken such provisions and woefully underfunded apparatus for their enforcement.

The evidence depicts that countries with an efficient enforcement mechanism and heavier penalties have low levels of counterfeiting. Legal amendments that may improve penalties and judicial procedures may help the Indian case. Improvement in customs inspection is another step towards eliminating counterfeiting.

Karan Vohra, head of enterprise business at NASSCOM, has highlighted that current erosion is so extreme that even the current laws need to be radically modified. The Cipla case is a landmark case that indicates how difficult it could be to enforce intellectual property rights in a volatile market. This situation represents how tough it is to protect intellectual property in this changing economic environment of the country.

Environmental Factors

Typically, fake products are produced in factories that are not regulated and, hence, do not have an opportunity to adhere to environmental conservation principles. The production of counterfeits also has economic implications and threaten public health and safety.

Valid supply chains can combat counterfeiters by building brand reputation and healthy consumerism. Companies engaging in green practice may thus be separated from counterfeiters; they can be regarded as operating outside the regulatory frameworks. Increased scrutiny of the production process may also spur more effective global climate policies, which would negatively impact the trade of fakes. Some of these counterfeit factories would be forced underground or to unregulated areas with poor environmental protections.

An example case study would be environmental degradation due to unregulated production facilities involved in counterfeiting, which has prompted a number of NGOs to call for more regulations on waste management in these industries.

In conclusion, a holistic approach to dealing with all these factors would be needed to build a robust IP for sustainable development against counterfeiting in the dynamic Indian economy.

Strategies for Brand Protection

Consolidation of Legal Frameworks

Legislative Reforms: Consolidate the strengths of existing IP laws through legislative reforms to strengthen judicial procedure and through inter-agency coordination for effective rights enforcement. International Agreements: The benefit of having international agreements like WTO TRIPS is that they provide surety and could ensure apt implementation standards concerning IP, thereby providing perfect brand protection.

Enforcements Strengthening

Specialized Enforcement Units: In-house specialized units within a law enforcement agency can be set up to investigate and prosecute IP crime, significantly augmenting enforcement capacity. Involvement with Law Enforcement Companies should involve law enforcement in carrying out anti-

Counterfeiting raids and sharing intelligence on counterfeiters' operations.

Awareness Public Awareness Campaigns

This could be a campaign to enlighten consumers and businesses about the possibility of counterfeit products and educate them about all the risks associated with this. "Make in India" should be the culture guarding such rights. Among the stakeholders, training programs have been running on how to protect IP, recognize counterfeits, and, therefore, empower them to act against infringement.

Application of Technology

Advancing technologies: Using blockchain and artificial intelligence in tracking and verification will reduce the incidence of counterfeiting. These technologies will trace the online availability of counterfeit products. Association with E-commerce Platforms: Association through these technologies with these e-commerce websites would give the brand a sound positioning in the virtual market

Active Brand Governance

Provision for Early Registration of IPs: To derive rights, Intellectual Properties need to be registered well before they are applied in new markets. Monitoring Online listings: Monitoring the online interfaces for listings of counterfeit products and acting promptly would safeguard the brand's reputation.

Further Gaps in Knowledge

Despite significant progress in grasping the intellectual property problems within India's dynamic market environment, much remains open for further research. Amongst these are areas that determine the impact current policies have and studies that give a broad analysis of current policies within India on the grounds of their effectiveness toward intellectual property protection. Future work could then identify the true levels of implementation of these policies and the extent to which these have contributed to reducing counterfeits and improving brand protection. Another area of concern is the consumer awareness level. While studies show that general consumer awareness on IP rights is very low, specific demographics or regions in India are not found to have been worst hit by this lack of awareness. Focused research could thus highlight which groups are these and suggest design changes for educational programs targeted toward the holes in those gaps.

Yet another emerging challenge is the aspect of technological adaptation in the enforcement of IP. For example, with the pace at which technologies are accelerating and changing, not much knowledge exists on how the sophisticated tools used in AI and machine learning may be manipulated for the betterment of the enforcement of IP rights. Exploration into these technologies can help yield new solutions that might combat counterfeiting among other IP issues.

Important cross-border enforcement challenges include several hard choices for Indian brands to negotiate enforcement issues when operating within foreign countries when it comes to IP theft and counterfeiting. A necessity to find effective strategies and frameworks that the Indian business system can use when negotiating over the international-level challenge.

Cultural factors also form part of the problem. Understanding societal attitudes toward counterfeiting can provide insightful information on consumer behaviour to help policymakers and businesses develop the strategy to reduce demand for counterfeit products. Lastly, there is an imperative need for longitudinal studies about brand equity to understand the

impact that effective IP protection has on brand value over a while across different sectors in India. The output will be brought together to feed into an even stronger understanding of intellectual property issues and guide effective strategies for brand protection in India's dynamic market.

CONCLUSION

This paper critically analysed the issue of counterfeiting and its implications on Indian brands within the context of global markets. Major findings show that, despite certain significant efforts India has placed toward the strengthening of its structure of IP protection, many challenges lie ahead. These involve the continuation of counterfeit activities, weak mechanisms of enforcement, and the overall lack of consumer awareness on the risks posed by counterfeit products. Analysis shows that the IP protection constitutes a basic framework of political measures, including National Intellectual Property Rights Policy and international agreements, including TRIPS, and their efficacy is hindered by non-consistency in the enforcement and the ignorance of the public. From an economic point of view, it is a grim threat for Indian brands with severe revenue loss and the deterioration of brand integrity. Socially, consumers keep choosing cheaper fake products, and therefore, this requires targeted campaigns that promote ethical consumption.

A multifaceted approach becomes imperative for effective tackling of counterfeit issues. Further facilitated through sharing best practices and access to resources on collaboration that involve government, businesses, and international collaborations through integrated technological intervention such as AI and blockchain by the anti-counterfeit strategies for Indian brands while further enhancing their means of detection or prevention of these counterfeited goods and services. Even though this research work contributes to the existing body of knowledge by providing insight into the status of IP protection in India, it also points to areas that are worthy of further investigation. In fact, it would be necessary to have deeper investigations to analyse how these policies and technologies might help curb the menace of counterfeiting in the long term. Further, consumer attitudes towards the counterfeit products by different demographics might be an important area of study to provide critical data for future anti-counterfeiting strategies.

Furthermore, the above evidence supports the argument that India needs to strengthen the protection offered by IP since it has a critical role in securing Indian brands in the international market from infringement. When India further liberalizes, its economy would be required to protect Indian brands; at the same time, it will improve the innovative environment and therefore, the country's economic prosperity. This commitment to fighting counterfeiting is part of a broader commitment to brand integrity and consumer safety, an effort that benefits all parties involved.

This paper will strive to leave the reader clearly aware of the complex nature of counterfeiting in India and encourage further discourse and action toward effective resolutions. Only by addressing these issues in a collaborative and innovative manner can India bestow upon itself its position as a prime mover in brand protection internationally.

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ECO-FRIENDLY PACKAGING: BALANCING INNOVATION AND ENVIRONMENTAL RESPONSIBILITY

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ABSTRACT

Eco-friendly packaging has arisen as a transformative answer in the battle against climate change and the harm caused by conventional packaging. As businesses and consumers start to emphasize sustainability, the challenge is to implement innovative packaging designs that are both eco-friendly and practical. This research examines the complex equilibrium among innovation, environmental accountability, and market forces in the realm of packaging. Utilizing SWOT Analysis along with a questionnaire, this study intends to deliver an in-depth examination of the eco-friendly packaging sector. The survey provided significant insights regarding consumer preferences, highlighting a strong inclination towards products utilising more sustainable materials such as paper of biodegradable plastics, over conventional plastic packaging. The findings indicate that consumers are increasingly aware of the environmental implications of packaging choices, which influence their purchasing decisions.

The results highlight that attaining a balance between innovation and sustainability requires a multi-faceted strategy, integrating technology, economics, and environmental safety. It is essential that ongoing research and development takes place in sustainable materials and methods to address the increasing need for environmentally friendly packaging solutions. In general, this research adds important information to the discussion on sustainable packaging, offering practical insights for companies seeking to meet consumer demands while reducing environmental effects.

KEYWORDS:

Packaging, Sustainability, Innovation, SWOT Analysis, Questionnaire, Consumer Preferences.

INTRODUCTION

Environment-friendly packaging has become the most significant area of focus in the global effort to eradicate environmental degradation and tackle climate change.

Innovative packaging solutions have taken the center stage in a race where all industries in the world seek to please consumers but represent the economy. It is involved with identifying the most cost-effective substitute to wasteful plastic packaging, so as to bring about waste reduction, conserve resources, and minimize the ecological footprint of the industry so far. Businesses and governments are adopting various creative policies and technologies to favour sustainability without minimising product integrity or functionality. Still, there are other challenges in shifting toward eco-friendly packaging, including cost, scalability, and accessibility. Cultural differences in many nations could delay the move toward green packaging. From an overarching perspective, however, it will also require a global cooperation, which would need to be able to align innovation with environmental stewardship into the mainstream. This is a global initiative that seeks to mainstream such a theme as it incites an increasing understanding that packaging is not merely a component of products but rather a critical process of sustainable development. In India, expanding concerns for environmental degradation and waste management have been charging a need for sustainable

Packaging solution. Eco-friendly packaging will encounter advanced commitment to the environment and also solve the never-ending difficulty of plastic pollution. With a vast consumer market and a sturdy manufacturing sector, India dispenses unique challenges and opportunities for adopting innovative packaging solutions that are cost effective as well as safe to the environment. India has witnessed a revolution in packaging from the use of biodegradable materials, consisting of jute and banana leaves to cutting edge compostable plastics and recycled materials.

Various government policies like the Plastic Waste Management Rules help in spreading the awareness of the consumers on sustainability. The balancing of innovation and ecological responsibility is going to be very crucial for India to meet its developmental goals while safeguarding the environment for future generations. packaging products is essential to prevent damage, spoilage, or contamination.

It all starts at the beginning of a package's life cycle and continues throughout, leaving a negative environmental footprint each step of the way. From its creation to its disposal, the negative environmental impact of most packaging materials is very concerning. Eco-friendly packaging shapes a powerful partnership between innovation and environmental responsibility, navigating the world towards a greener and a sustainable future. By embracing high-tech advancements, companies can meet the consumer needs while reducing their carbon footprint. Innovative packaging reduces waste and conserves resources while aiding a circular economy where materials are reused and recycled rather than discarded. As businesses explore and invest in sustainable forums, environmental supportive packaging shifts from being an imperative to a catalyst for sustainable growth and a testament to humanity's ability to align creativity with ecological management.

REVIEW OF LITERATURE

ECO FRIENDLY PACKAGING

Sustainable packaging has arisen as a solution to increasing environmental issues related to conventional packaging materials, particularly plastics. Sustainable packaging materials aim to minimize environmental effects and should, in an ideal world, be recyclable, biodegradable, compostable, or derived from renewable sources (Rundh, 2016). Consequently, the advancement of packaging is shifting towards sustainability because of evolving consumer attitudes, technological progress, and the enforcement of regulations.

As per Kumar et al. (2018), implementing eco-friendly packaging counters the exhaustion of natural resources and helps reduce waste by integrating sustainability into production or disposal methods.

Types of Eco-Friendly Packaging: Several types of eco-friendly packaging materials have been studied in the literature:

Biodegradable Packaging: Derived from natural resources like starch and cellulose. Song et al. (2009) note that biodegradable packaging decomposes naturally, reducing pollution.

Recyclable Packaging: Materials that can be used repeatedly, such as paper, glass, and metals.

According to Hopewell et al. (2009),recycling has a direct impact on decreasing
resource use.

Compostable Packaging: Compostable materials like bagasse and polylactic acid

(PLA) break down into organic material given the right conditions (Davis & Song, 2006).

Edible Packaging: Emerging innovations, such as seaweed-based or protein-based films, are gaining attention as per Rhim et al. (2013).

Consumer Attitudes Toward Eco-Friendly Packaging

Consumer perception is crucial in the acceptance of eco-friendly packaging. Magnier and Crié (2015) observed that consumers are growing more conscious of the ecological impact of packaging waste and Favor brands that utilize sustainable packaging.

Conversely, research like that of Steenis et al. (2017) indicates reluctance to embrace eco-friendly packaging because of perceived issues with durability and costliness.

As stated by Pires et al. (2020), campaigns aimed at raising awareness and effective labelling will enhance consumer confidence and acceptance of environmentally friendly options.

Technological Advancements in Sustainable Packaging.

Recent technological advancements have enabled innovative solutions:

Bioplastics and Bio-Based Polymers:

Muthuraj et al. (2018) emphasize the role of bio-based materials like PLA, PHA, and bio-polyesters in replacing traditional plastic packaging.

Edible and Water-Soluble Films:

Research by Rhim and Ng (2007) highlights the potential of edible packaging materials derived from seaweed and starch.

Smart Packaging: Combining sustainable materials with technology to improve tracking, shelf-life, and reduce food waste (Vanderroost et al., 2014).

Environmental Impact of Eco-Friendly Packaging

Sustainable packaging significantly lessens environmental damage. As stated by Ncube et al. (2020), sustainable packaging decreases carbon emissions and minimizes landfill waste. They highlight those materials like bioplastics lower dependence on fossil fuels while maintaining the same functions as conventional plastics.

López et al. (2014) found that packaging made from plant-based materials like PLA generated 25% fewer greenhouse gas emissions compared to petroleum-based plastics at the production stage.

METHODOLOGY

The research methodology for this paper on eco-friendly packaging: balancing innovation and environmental responsibility employs the SWOT analysis. It has four main aspects- Strengths, Weaknesses, Opportunities, Threats. Performing SWOT Analysis helps to not only recognise the strengths and weaknesses, but to also figure out creative ways as to how to utilise these in the best way possible to maximise the opportunities and threats of a business. It assesses the internal and external factors that influence a business, and helps identify potential to improve. This framework helps businesses recognize their competitive standing and develop strategies to improve overall performance and achieve their goals.

RESULTS/ANALYSIS- OUTCOMES

Strengths-enhanced brand reputation; material innovation; environmentally friendly- reduces carbon footprint; little to no toxins and allergens

Weaknesses-higher costs; complex supply chains; lack of consumer education; lack of Infrastructure.

Opportunities-versatile uses; increase in customer base- new fascinating product in shelf; government support; technological advances; circular economy; integration of localised jobs (e.g. farming); mostly non targeted market- further potential

Threats-traditional packaging competition; market saturation; economics fluctuations

Strengths:

Eco-friendly packaging improves brand loyalty, as it proves the brand's commitment towards the environment. It improves the brand image, and increases the value customers hold towards the brand or company. Eco plastics, such as biodegradable and bioplastics, offer various benefits that enhance sustainability. They greatly lower carbon emissions in the production process and use less energy, since many originate from renewable sources, preserving natural resources. Their biodegradable properties enable them to decompose naturally, reducing landfill waste and pollution. Moreover, eco plastics are typically non-toxic, guaranteeing safety for both consumers and the environment. As consumer demand for sustainable items rises, businesses utilizing eco-conscious packaging can improve customer loyalty. In general, eco plastics serve as a feasible substitute for conventional plastics, supporting worldwide
environmental objectives.

Weakness:

The weakness of this eco-plastic is the constant supply of raw materials for the production of the plastic. The farmers sometimes face difficulties in production of the root crops and vegetables because of climate issues- the dependence on the agricultural sector for raw materials creates an uncertain situation.

Opportunities:

Eco-plastic production will give more opportunities to the local farmers and low-income earners to start agricultural production and become the raw material suppliers to our company for the smooth and non-stop production of biodegradable plastic bags. Moreover, our product can also be sold in South Pacific regional countries and they can also benefit from environmentally friendly eco-plastic ideas. South Pacific countries are vulnerable to climate change and its horrors hence, switching to eco-friendly and reducing less carbon-dioxide will benefit all. Also, the current government placed a levy on normal plastic bags, and if our eco-plastics are in the market, consumers will go for our products as there will not be any levy on them due to its environmentally friendly nature. Furthermore, after successful production of eco-plastic bags, we can also start producing eco-plastic plates, cups, eco-plastic kitchen utensils, biodegradable bottles and so forth.

Threats:

Introduction of new products similar to plastic bags are the biggest threat to our product. Some people might not care about the "edible" aspect of our biodegradable plastic bags and just choose to go with ones that can be thrown away at the end of every use. Another threat is the price of agricultural produce is also a concern, if the market demand increases the cost might also increase, and this may eventually increase the price of our eco-plastic.

Additionally, a survey was also conducted to analyse the market for sustainable products. Hundred and forty responses were received, out of which twenty-four respondents were between 16-18 years of

age, thirty between 18-21, six from 21-24 and seventy-nine from 25 and above. Seventy-three responders consumed food and beverage products the most, while forty-three responders spent the most on household goods. The sustainability of a product was held in high regard by seventy-three respondents. However, only 59 actively checked for sustainable alternatives to their everyday used products. This pointed out an essential part of sustainable packaging- visibility. Labelling and designing of a product should be done in a manner that shines out to consumers and grabs their attention, signifying that the brand is sustainable. This is primarily signified by using green, associated with nature and naturally produced products. A standard must be introduced by the government, which assigns either a specific symbol or notation for sustainable and eco-friendly products, even on the basis of packaging. Better awareness is required from the side of producers and marketers to ensure that consumers are aware of all the available eco-friendly alternatives. Thirty-three responders felt that better labelling would motivate them to purchase products with sustainable packaging. Around fifty-eight responders preferred biodegradable packaging, as it has the advantage of convenient disposal. There is no after-work involved with reusing or recycling packaging. A consumer can discard the product and be guilt-free. However, around 56 responders also preferred recyclable packaging. This has become a more popular option thanks to the Government's initiatives to promote segregation during waste disposal. Garbage collecting agents and centres have unique processes for recycling green packaging, which is convenient for consumers. However, while initiated and in place, many have not utilised it. This needs to change, and more awareness should be made regarding the various governmental and NGO centres available to dispose of recyclable waste.

Fifty-eight respondents felt that better availability of eco-friendly packaging would encourage them to choose sustainable alternatives, while forty-five respondents felt that lower-cost alternatives would motivate them. Most responders [89] are informed about sustainable packaging through social media or brand websites. This is due to the digital era we live in, where research on a product is done online rather than in-store. More advertising and marketing are required from the side of brands to ensure consumers are informed about their sustainable packaging and thus motivate them to choose the ex-friendly option. Responders were divided when it comes to whether a brand would have an advantage when it comes to having sustainable packaging. Yes, a brand is viewed better and has a better image with more sustainable measures and packaging. However, many felt that despite sustainability, factors like price played a more significant role, thus emphasising the importance of providing low-cost sustainable packaging alternatives. However, this cannot be expected from big brands alone. Consumers pay attention to details like packaging and sustainability when shopping from small, no-name brands. However, the opposite should be the case, where big-name brands and corporations should take the initiative to kick-start the sustainable packaging movement on a bigger scale so that other brands will follow. MNCs possess the resources and technology to dedicate significant amounts of time and money towards research and development of better

packaging. The same cannot be said for smaller startups stepping into the field. More responsibility is placed on government-produced products and to utilise more local packaging alternatives, such as jute and hay, instead of plastic. While readily available, they damage our planet more than we can imagine.

CONCLUSION

Eco-friendly packaging has become the need of the hour in the marketing sphere. With more and more awareness being raised regarding climate change and sustainable products, packaging has also come under scrutiny. Globally, it's estimated that 50% of plastic packaging waste is sent to landfills, with the remaining 50% either incinerated or leaked into the environment (Source: OECD's Global Plastic Outlook). This statistic calls for immediate action and change. Many consumers do not fully comprehend the impact of the plastic bag they throw, or the clear saran wrap they discard. Even these small pieces of plastic leave their mark on our Earth. This study poses the question- if not plastic, what else? and attempts to answer the same. The aim of this study is to analyse the existing packaging used for products, evaluate them on the basis of sustainability and identify any suitable and viable alternatives to plastic.

By way of questionnaire, data was collected and analysed by use of swot/tows analysis, and a consensus achieved regarding whether or not people are willing to spend more than regular if the product packaging is of eco-friendly material. The outcomes shed light on multiple facets- first being the impact of plastic packaging. By examining the alternatives available in the market, the most feasible solution in the long run is to be determined.

However, quite a few factors are taken into account, being feasibility in the long run, market view and customer satisfaction, and environmental impact. While all of these solutions are hard to achieve on their own, with combined innovation and invention, a sustainable solution can be achieved to the problem of plastic packaging. Many brands have shown an initiative towards switching to more eco-friendly, biodegradable alternatives. However, this shift has been seen in smaller brands and not by large corporations. This seems to be paradoxical, as large brands have designated Research and Development departments which have the capacity to invest large amounts of time and money into developing sustainable alternatives. Consumer behaviour also shows many do not hold these brands accountable for the same- choosing to buy repeated bottles from big brands and posing the question of sustainability only towards small brands. This is a fault on consumers as well, as only with proper force a solution can be achieved.

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OPTIMIZING QUICK COMMERCE: THE TRANSFORMATIVE ROLE OF PREDICTIVE ANALYTICS IN INVENTORY MANAGEMENT

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ABSTRACT

With lightning-fast delivery services, Quick Commerce has revolutionized the Indian e-commerce business, necessitating effective inventory management. Significant obstacles are presented by erratic demand and logistical difficulties, nevertheless. By boosting service delivery, optimizing stock levels, and improving demand forecasting, the emergence of big data and AI-driven predictive analytics has completely changed inventory management. This study emphasizes how crucial predictive models are to maintaining the expansion of rapid commerce by facilitating demand-driven and hyper-localized tactics. By implementing these cutting-edge technologies, companies may enhance consumer experiences while cutting expenses and waste, establishing predictive analytics as a major force behind India's rapidly developing quick commerce industry.

KEYWORDS:

Predictive analytics, quick commerce, inventory management, demand forecasting, operational efficiency, sustainability

INTRODUCTION

Background:

In order to meet the demands of urban consumers for speed and convenience, quick commerce, or q-commerce, is a quickly expanding subset of e-commerce in India that offers incredibly quick product delivery, frequently in 10 to 30 minutes. Improvements in logistics, a rise in internet usage, and shifting consumer habits following the pandemic have all contributed to its acceleration. This market is dominated by Indian companies that use micro-warehouses and hyperlocal networks, such as Blinkit, Zepto, and Swiggy Instamart. By 2025, the Indian Quick commerce market is expected to reach $5.5 billion, according to a Red Seer study.

In quick commerce, inventory control is essential to guaranteeing lightning-fast delivery while reducing overstocking and stockouts. It uses hyperlocal micro-warehouses, which are frequently positioned in crowded places, to effectively store things that are in great demand. Demand forecasting and stock level optimization heavily rely on cutting-edge technology like artificial intelligence (AI) and predictive analytics. Real-time inventory tracking is crucial for improving operational efficiency, according to a study by Arora et al. Despite its advantages, quick commerce inventory management has drawbacks, including high operating costs and adjusting for variations in demand.

Quick commerce is being revolutionized by predictive analytics, which makes it possible to foresee demand accurately and allocate resources efficiently. It makes sure the correct products are stocked at hyperlocal warehouses by using machine learning algorithms and historical data to forecast consumer behaviour. Predictive analytics increases operational efficiency by decreasing waste and speeding up deliveries. Personalized recommendations are another way it may be used to assist businesses increase customer retention and satisfaction. However, the quality of the data and ongoing algorithm improvement are essential to predictive analytics' success.

Ultra-fast delivery is the essence of quick commerce, demanding sophisticated technologies and strong inventory

management techniques. In hyperlocal warehouses, predictive analytics is essential for forecasting demand, optimizing stock levels, and improving operating efficiency by utilizing data-driven insights. In a highly competitive market, these advancements work together to help businesses strike a balance between speed, precision, and cost-effectiveness.

OBJECTIVES

1. To analyse the role of predictive analytics in improving inventory management processes for quick commerce.
2. To explore the challenges and limitations of inventory management in quick commerce.
3. To review existing research and case studies to identify best practices in inventory optimization.
4. To evaluate the impact of predictive analytics on supply chain agility and cost management.
5. To propose actionable insights for integrating predictive analytics into inventory management for sustained growth.

SCOPE

The scope of this paper is to explore the transformative

role of predictive analytics in optimizing inventory management for quick commerce businesses. It examines theoretical insights from existing academic literature, analyses industry reports to highlight market trends and challenges, and reviews real-world use cases of companies utilizing predictive analytics to improve inventory efficiency. The focus is on understanding the impact of predictive analytics on operational costs, delivery speed, and customer satisfaction. This study does not include primary data collection, technical breakdowns of algorithms, or comparisons with traditional inventory management in other sectors.

REVIEW OF LITERATURE

Introduction:

This chapter includes reviews for determinants of predictive analytics in inventory management. The articles are grouped under each determinant.

Literature Review:

Yusof (2024) discovered about analysing the role of predictive analytics and machine learning techniques in Optimizing Inventory Management and Demand Forecasting for E- commerce. The aim of the research is to establish a framework for the successful implementation of predictive analytics in managing inventory and forecasting demand. The research explores essential techniques like regression analysis, time-series forecasting, clustering, and neural networks, as well as their practical uses in real-life situations. The findings of the study underscore the advantages of predictive analytics in preventing stock shortages, decreasing excess inventory, and lowering operational expenses. The research recognizes obstacles including problems with data quality, biases in algorithms, and the intricacies of execution.

Perumalsamy & Natarajan (2010) studied Predictive analytics using Genetic Algorithm for efficient supply chain inventory optimization. Effective inventory management is a challenging task that involves overseeing inventory across the entire supply chain. The fluctuating levels of surplus and shortages throughout different periods present a significant challenge during implementation. Furthermore, managing multiple factories and a variety of products adds to the complexity of the inventory management process. When more distribution centres and agents are engaged, the problem

becomes more complex. This paper focuses on inventory management issues and proposes a novel approach based on genetic algorithms. This approach determines the most likely excess stock level and shortage level needed for supply chain inventory optimisation in a unique way to minimise overall supply chain costs.

Agarwal et al (2023) discovered about the role of predictive analytics in Inventory Management. This abstract's goal is to examine how predictive analytics might transform the way inventory management procedures are conducted. This is achieved by estimating future inventory needs utilising statistical algorithms, machine learning techniques, and historical data. Data gathering, model building, validation, and deployment are some of the crucial elements in the suggested methodology for using predictive analytics in inventory management. This strategy seeks to improve risk management, optimise inventory levels, and improve demand forecasts. Predictive analytics is essential to modern inventory management because it may change outdated procedures through forecasting and data-driven insights.

RESEARCH METHODOLOGY

Sources Of Data:

The research was conducted using secondary
data sources. Secondary data was obtained from various research studies carried out by scholars, academicians and authors worldwide, sourced from both online and offline platforms.

PREDICTIVE ANALYTICS IN INVENTORY MANAGEMENT

Present Status:

Predictive analytics has emerged as a critical tool in modern inventory management, enabling businesses to forecast demand, optimize stock levels, and reduce wastage. Its current applications include leveraging machine learning algorithms to analyse historical data and predict future trends, thereby enhancing supply chain efficiency and customer satisfaction. Companies across industries are increasingly adopting predictive analytics to manage inventory challenges in fast-paced environments like quick commerce.

Demand Forecasting in Quick Commerce:

Demand forecasting in quick commerce leverages predictive analytics to anticipate customer needs and ensure optimal inventory levels. By analysing historical data, seasonality, and purchasing patterns, businesses can accurately predict demand spikes and fluctuations. This capability is crucial for meeting the high-speed delivery expectations of customers while minimizing stockouts and overstocking. Companies like Zepto utilize advanced AI-driven models to forecast demand during peak periods, such as festivals or weekends, enhancing operational efficiency and customer satisfaction. As quick commerce grows, demand forecasting remains a cornerstone of effective inventory management, driving agility and competitiveness.

Use Cases:

1. In 2021, Zepto, a leading quick commerce platform in India, integrated AI-driven demand forecasting models to optimize inventory management. These models analyse historical sales data, real-time purchase trends, and external factors like weather or regional events to predict demand spikes with high accuracy. By leveraging predictive analytics, Zepto dynamically adjusts stock levels across

its hyperlocal warehouses, ensuring popular products are available during peak demand periods, such as festivals or weekends. The system also minimizes wastage by preventing overstocking of slow-moving items. This AI-based approach has significantly enhanced Zepto's operational efficiency and customer satisfaction, positioning it as a leader in the quick commerce industry. WareIQ. (2024). *Swiggy Instamart vs. Zepto: Quick Commerce Giants Compared*. [online]

2. In 2021, Amazon integrated a cutting-edge predictive analytics platform to improve demand forecasting and inventory management processes. By processing extensive data, including customer habits, seasonal variations, and purchasing patterns, the system provides precise demand projections. This allows Amazon to maintain optimal inventory levels, reduce storage costs, and enhance product availability, thereby elevating customer satisfaction. Additionally, the system enables dynamic pricing adjustments in real-time, leveraging demand forecasts and market dynamics. This holistic application of predictive analytics has been pivotal in strengthening Amazon's dominance within the e-commerce industry. *Predictive Analytics in Retail & E-Commerce: Use Cases*, 2021

Real-Time Inventory Tracking and Replenishment

Real-time inventory tracking and replenishment leverage predictive analytics to maintain optimal stock levels and streamline supply chain operations. By continuously monitoring inventory data and integrating predictive models, businesses can anticipate shortages or surpluses and take corrective actions proactively. This capability is critical in quick commerce, where meeting tight delivery timelines hinges on efficient inventory management. Platforms like Zepto utilize real-time analytics to ensure their hyperlocal warehouses remain stocked with high-demand items while minimizing excess inventory. Such advancements highlight the transformative potential of predictive analytics in enhancing agility and operational precision in the quick commerce sector.

Use cases:

1. In 2021, Blinkit (formerly Grofers) implemented real-time inventory tracking powered by predictive analytics to enhance operational efficiency. The system integrates data from customer orders, warehouse stock levels, and supplier inputs to maintain a continuous supply of high-demand items in hyperlocal hubs. Using AI algorithms, the platform forecasts potential stockouts and automates reordering to ensure timely replenishment of fast-moving goods. This real-time tracking solution significantly reduces delayed deliveries, optimizes inventory holding costs, and enhances customer satisfaction by maintaining stock availability. The adoption of predictive analytics has positioned Blinkit as a leader in quick commerce operations. TechSciResearch, (2025). *Blinkit: Revolutionizing the Retail Experience*. [online]
2. In 2021, Amazon utilized a predictive analytics system to enhance inventory management and customer satisfaction. The system analyses vast datasets, including historical sales, customer

behaviour, and external factors like holidays or weather, to forecast demand accurately. This enables Amazon to optimize inventory levels, ensuring popular products are always in stock while minimizing excess inventory. Additionally, predictive analytics powers Amazon's dynamic pricing strategies, which adjust prices in real time based on demand predictions and market trends. By integrating predictive analytics into its operations, Amazon has strengthened its supply chain efficiency and maintained its leadership in e-commerce. devteam (2024). *Predictive Analytics in Retail & E-commerce: Use Cases – InData Labs*. [online]

3. In 2024, a report highlighted the transformative impact of AI-powered demand forecasting in the fashion industry. The industry faces significant inventory management challenges, with billions of dollars in unsold stock annually due to fast, trend-driven cycles and global disruptions. AI-powered demand forecasting tools, such as those developed by startups like Autone, Singuli, and Prediko, are emerging as potential solutions. These tools analyse various data points to provide actionable insights, helping retailers optimize stock levels, forecast demand more accurately, reduce waste, and increase efficiency. The sustained investor interest in these AI-driven solutions indicates a robust future for their application in fashion retail.
4. In 2024, a report discussed the role of predictive analytics in retail and e-commerce, highlighting its applications in personalized marketing, dynamic pricing, and demand forecasting. By analysing customer data and market trends, retailers can anticipate future behaviours and trends, enabling them to make data-driven decisions that enhance customer satisfaction and operational efficiency. The report emphasizes that predictive analytics is becoming increasingly integral to retail strategies, helping businesses stay competitive in a rapidly evolving market.
5. In 2024, a report explored how predictive analytics can help retail and e-commerce brands reduce stockouts. By analysing historical and real-time data, predictive analytics enables businesses to forecast demand accurately, optimize inventory levels, and prevent stockouts. This leads to improved customer satisfaction and increased sales, as products are available when customers want them. The report underscores the importance of integrating predictive analytics into inventory management systems to enhance efficiency and profitability.

LIMITATIONS OF PREDICTIVE ANALYTICS IN INVENTORY MANAGEMENT

High Initial Costs

Implementing predictive analytics systems requires significant financial investment in advanced software, infrastructure, and skilled personnel. For Indian SMEs, this can be a prohibitive factor, limiting their ability to adopt such technologies. The expenses do not end at setup; regular maintenance, system upgrades, and integrating predictive tools with legacy systems add to the burden. For instance, companies might struggle to justify the ROI initially due to these steep upfront costs. Nikhil (2024). *AI for Inventory Management Explained - Carmatec*. [online]

Data Quality and Integration Issues

Predictive analytics systems thrive on high-quality, consistent, and comprehensive data. In India, fragmented data collection practices and inconsistent formats are common, making it challenging to derive accurate predictions. Legacy systems often compound the problem, as they do not integrate easily with modern analytics platforms. This can lead to inaccurate forecasts, ultimately hindering decision-making processes. Verma, S. (2024). *What is the role of predictive analytics in supply chain management?* [online]

Complexity of Implementation

Deploying predictive analytics involves sophisticated algorithms, statistical tools, and machine learning models, requiring extensive expertise. Many Indian companies lack access to the skilled workforce needed to implement and manage these systems effectively. The learning curve for setting up and optimizing these tools can lead to delays, mismanagement, or suboptimal usage of predictive analytics technology. Verma, S. (2024). *What is the role of predictive analytics in supply chain management?* [online]

Data Privacy and Security

Concerns The use of customer and operational data in predictive analytics brings up significant privacy and security issues. Indian businesses must comply with global and local data protection laws, such as GDPR and the Personal Data Protection Bill, which adds layers of complexity and cost. Mishandling data can lead to breaches, legal consequences, and loss of consumer trust, making robust cybersecurity measures a necessity. Insight software (2023). *The 4 Common Predictive Analytics Challenges and Solutions*. [online]

Scalability Challenges

Scaling predictive analytics to match business growth or market dynamics is a common challenge. As companies expand, data volume and variety increase, requiring systems that can scale effectively. Many Indian companies, especially SMEs, may find it difficult to maintain the same level of accuracy and efficiency in their predictive models without incurring significant costs. Verma, S. (2024). *What is the role of predictive analytics in supply chain management?* [online]

Resistance to Change

Cultural and organizational resistance can hinder the adoption of predictive analytics. Employees may resist new systems due to a fear of job displacement or increased workload. For many Indian businesses rooted in traditional practices, transitioning to data-driven decision-making requires extensive change management and training to secure stakeholder buy-in. By addressing these drawbacks, Indian businesses can better position themselves to harness the transformative potential of predictive analytics. While larger organizations with substantial resources may find ways to overcome these barriers, smaller firms must carefully evaluate their readiness and weigh the potential benefits against these challenges.

INTERPRETATION

This section delves into the implications and significance of the findings, interpreting how predictive analytics transforms inventory management in India's quick commerce sector. Key insights are explored below.

KEY FINDINGS

Demand Forecasting as a Cornerstone

Predictive analytics has proven to be a cornerstone in enabling accurate demand

forecasting. Companies like Zepto and Amazon utilize AI-driven systems to anticipate demand spikes, ensuring seamless operations during peak periods. By leveraging historical sales data and external factors, these platforms optimize inventory levels, reducing stockouts and overstocking. However, the success of these systems hinges on data quality and algorithm refinement, highlighting a critical dependency for sustained effectiveness.

Real-Time Inventory Tracking for Agility

The integration of real-time inventory tracking with predictive analytics enhances agility in supply chain operations. Platforms like Blinkit implement AI models to monitor stock levels continuously and automate replenishment processes, reducing delays and ensuring availability of high-demand items. This capability is essential for meeting the ultra-fast delivery promises characteristic of quick commerce. Yet, these systems require substantial investment, making them less accessible to smaller enterprises.

Cost and Waste Optimization

One of the standout benefits of predictive analytics is its ability to reduce costs and waste. Through precise inventory management, companies can minimize holding costs and avoid wastage, particularly with perishable goods. For instance, real-time tracking combined with demand forecasting enables businesses to align stock with customer needs. While this aligns with sustainability goals, the high implementation costs pose challenges for SMEs aiming to adopt such practices.

CHALLENGES AND LIMITATIONS

Data Quality and Integration

The study identifies fragmented data systems and inconsistent data collection practices as significant barriers. For predictive analytics to deliver accurate results, businesses must invest in robust data integration strategies. The lack of standardization in data collection further complicates predictive model development, leading to potential inaccuracies in forecasting.

Scalability for Diverse Markets

Scalability remains a critical concern, particularly for SMEs. Large enterprises like Amazon effectively scale predictive models across varied markets, but smaller firms struggle to replicate such success due to financial and technological constraints. Ensuring scalability without compromising accuracy or efficiency is a challenge that requires continuous innovation.

Regulatory and Privacy Concerns

With the increased reliance on customer data, privacy and compliance concerns become paramount. Businesses must navigate stringent regulations like the Personal Data Protection Bill, which necessitate additional resources for secure data handling and compliance management. Mishandling data risks not only legal repercussions but also a loss of customer trust.

BROADER IMPLICATIONS

Strategic Asset for Competitive Advantage

The study demonstrates that predictive analytics is not just a tool but a strategic asset. By leveraging these systems, companies can enhance customer satisfaction, operational efficiency, and cost-effectiveness. This positions them as leaders in the competitive quick commerce landscape.

Potential for Wider Adoption

As AI and machine learning technologies advance, the barriers to adopting predictive analytics are expected to lower. This could democratize access, enabling smaller

businesses to integrate these systems into their operations. Future research and development should focus on creating scalable, cost-effective solutions to benefit a broader spectrum of enterprises.

CONCLUSION

The rapid evolution of quick commerce in India has placed immense pressure on businesses to optimize their operations while meeting the rising expectations of urban customers. This study highlights predictive analytics as a transformative force in inventory management, enabling companies to forecast demand, streamline stock levels, and reduce operational inefficiencies. By employing real-time tracking and replenishment strategies, businesses like Zepto, Blinkit, and Amazon have demonstrated the tangible benefits of predictive tools in ensuring high-speed deliveries and cost savings.

However, the analysis also underscores significant challenges, including high implementation costs, data quality issues, and scalability concerns. While large organizations have leveraged predictive analytics effectively, smaller enterprises face barriers that hinder adoption. Addressing these obstacles requires innovation, collaboration, and targeted investments to make predictive systems more accessible.

As the Indian quick commerce market continues its exponential growth, the role of predictive analytics will become even more critical. Future advancements in AI and machine learning are likely to enhance the efficiency, affordability, and scalability of these tools, paving the way for broader adoption. By overcoming current limitations, businesses can achieve a competitive edge, delivering exceptional customer experiences while driving sustainable growth in a highly dynamic sector.

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SESSION II

BUSINESS MODELS AND LOGISTICS IN QUICK COMMERCE

CONSUMER BEHAVIOUR IN THE AGE OF QUICK COMMERCE: A PRE-POST PANDEMIC STUDY

Padma S, Subaprada G R

Quick commerce has rapidly changed how consumers shop, introducing a new era of convenience and speed in online retail. This research delves into the psychological and behavioural factors driving this shift. By analysing pre- and post-pandemic trends, we explore how convenience, impulse buying, and evolving consumer expectations, busy lifestyle has shaped the success of quick commerce. It also includes a comparative analysis of service efficiency across leading quick commerce platforms, exploring how they meet consumer needs and drive competition.

The study begins by introducing the concept of quick commerce, tracing its evolution, and analysing its profound impact on consumer behaviour in the digital marketplace. Primary data was collected via online surveys targeting diverse consumer demographics, while secondary data was sourced from systematic literature reviews, industry reports, and reliable web-based resources.

The research demonstrates that quick commerce is not merely a trend but a transformative force that leverages advanced technology to align with shifting consumer preferences. This rapidly evolving industry is poised to redefine the retail landscape, offering ultra-convenient solutions while addressing challenges related to sustainability and market saturation.

KEYWORDS:

Q-Commerce, Covid-19 pandemic, Purchase decision, Behavioural economics, Customer experience.

INTRODUCTION

The dynamic and diverse study of consumer behaviour reflects how people's tastes, routines, and decision-making processes change over time. The complex link between customers and their surroundings is reflected in these changes, which are frequently influenced by societal, economic, and technical shifts.

Quick commerce, which is defined by **lightning-fast delivery services**, has revolutionized how customers interact with goods and services by offering unparalleled ease and promptness that are now necessary for modern lives. This change was further expedited by the COVID-19 pandemic, which changed consumer preferences by highlighting the need for speed and convenience like never before through lockdowns and safety concerns that pushed a shift towards digital solutions.

Q-commerce is an innovative breakthrough in the retail industry that was created especially to satisfy the need for immediate access that current consumers have. Q-commerce places a higher priority on completing small orders, such groceries, personal care products, and daily essentials, in a matter of minutes as opposed to traditional e-commerce, which frequently depends on scheduled delivery. In order to guarantee quick and effective service, this strategy depends on **hyperlocal logistics**, placing delivery hubs close to customers. Businesses like **Blinkit, Zepto, Swiggy, Instamart, and Dunzo** have become industry leaders in this field, redefining customer expectations in the digital marketplace and establishing new benchmarks for delivery speed. The ability of q-commerce to meet the demands of fast-paced urban living is a key factor in its success. In order to meet the growing demand for rapid gratification, q-commerce platforms have optimized their operations by leveraging cutting-edge technology like

AI-driven logistics and real-time inventory management. This retail model has become more and more popular all over the world, driven by both psychological and technological considerations, such as consumers' increasing time restrictions and desire for convenience.

This study investigates how the emergence of q-commerce has affected customer behaviour. It seeks to document the evolution of this novel retail concept and assess how it has affected consumer purchasing patterns. This study aims to determine how societal shifts, technical advancements, and evolving consumer demands have contributed to the explosive growth of q-commerce by comparing trends before and after the epidemic. The results will provide important light on the elements that contributed to its success and its ramifications for retail's future.

LITERATURE REVIEW

Shivom Gupta (March–April 2024) offers an in-depth analysis of the Quick Commerce ecosystem, including its development, expansion, major participants, and the difficulties faced by grocers, retailers, and e-commerce businesses. The study also looks into Quick Commerce's regulatory environment and policy ramifications, highlighting certain regulatory obstacles and the necessity of a well-balanced regulatory framework to support long-term growth. To sum up, this study offers insightful information about the revolutionary potential of Quick Commerce in India, providing industry participants, stakeholders, and policymakers with a sophisticated grasp of the opportunities and difficulties that come with the quick development of this vibrant sector.

Gauri Ranjekar (March 2023) examines how consumers make decisions about online grocery purchases based on important factors like perceived ease of use, e-service quality, and electronic word-of-mouth (e-WoM), with e-trust acting as a mediator. The investigation, which makes use of Structural Equation Modelling (SEM) tools and data gathered from 125 respondents, shows that consumer e-trust is positively impacted by both e-service quality and e-WoM. Furthermore, these elements have a big impact on customers' purchasing decisions when combined with e-trust itself. The study recommends enhancing compensation services, giving application usability first priority, and continuously monitoring all Astro-related data in order to promote good e-WoM for the Astro platform.

A controlled online experiment and a sizable customer-level transaction data set from a Western European food delivery service are used by **Alice Harter, Lucas Stich, and Martin Spann (March 2024)** to investigate the impact of delivery time discrepancies on repurchase behaviour. The findings indicate that interpurchase intervals are increased (decreased) by late (early) deliveries; these effects lessen with more variances. The findings also indicate that compared to early deliveries of the same size, late deliveries have a greater impact on repurchase behaviour. Customer satisfaction is the psychological process that underlies the influence of delivery time discrepancies on repurchase behaviour, according to the controlled online experiment. By supporting earlier studies on disconfirmed waiting times and rapid commerce, these findings contribute to our understanding of delivery time variances and repurchase behaviour. The findings can be used by practitioners.

RESEARCH METHODOLOGY

With an emphasis on comprehending consumer behaviour in the era of rapid commerce, this chapter describes the research approach. The study used a quantitative methodology, collecting primary data from individuals in a range of demographic groups using surveys. To give the analysis context and support, secondary data was gathered from reputable online sources, industry papers, and scholarly literature.

Data Collection

A survey was distributed online via a Google Form to ensure accessibility and convenience for respondents. A total of 52 participants, representing a diverse range of age groups and occupations, completed the survey. The responses offered valuable insights into the evolving consumer behaviours and preferences, particularly in the context of quick commerce.

Survey Design

The survey was designed to capture insights into consumer behaviour before and after the pandemic, focusing on the use and perception of quick commerce platforms. The questionnaire included a mix of demographic questions and specific inquiries about usage patterns, preferences, and expectations. The survey was structured to address the following key areas:

1. **Demographics**:

Age groups: Under 18, 18–24, 25–34, 35–44, 45+.

Primary occupation: Student, Working Professional, Homemaker, Retired.

2. **Usage Frequency**:

How frequently participants used quick commerce platforms before and after the pandemic, categorized as:

Rarely/Never, Once a month, Once a week, Multiple times a week.

3. **Platform Preferences**:

Identification of the most-used platforms (e.g., Blink it, Dunzo, Zepto, BigBasket, Swiggy Instamart, Amazon Fresh) before and after the pandemic.

4. **Product Categories**:

The types of products ordered most frequently, including groceries, household essentials, electronics, beauty and personal care, and medicines.

5. **Decision-Making Factors**:

Key factors influencing the use of quick commerce platforms, such as:

Speed of delivery, Convenience, Impulse buying, Busy lifestyle, Impact of COVID-19.

6. **Desired Improvements**:

Suggestions for enhancements in quick commerce services, including:

Faster delivery times, Better product variety, Improved pricing/offers, Enhanced customer support, Eco-friendly delivery options.

Data Analysis

To find trends and patterns in consumer behaviour both before and after the epidemic, the gathered data was examined. To determine how the pandemic affected the rapid adoption of commerce, a comparative examination of usage frequency, platform preferences, and product categories was conducted. To give the industry useful information, the elements affecting decision-making as well as the intended enhancements were assessed.

Limitations

While the survey provided meaningful data, the sample size of 52 participants may limit the generalizability of the findings. To obtain a deeper understanding of customer behaviour, future research could increase the number of participants and use qualitative techniques like interviews.

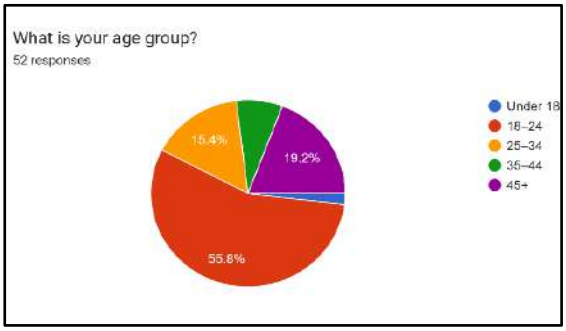
ANALYSIS AND INTERPRETATION

This chapter analyses responses from a Google Form survey completed by 52 participants, providing insights into consumer behaviour and preferences regarding quick commerce platforms. It highlights trends in usage frequency, preferred services, product categories, influencing factors, and desired improvements, reflecting the evolution of consumer habits, especially post-pandemic.

Demographic profile of the respondents

Age cohort

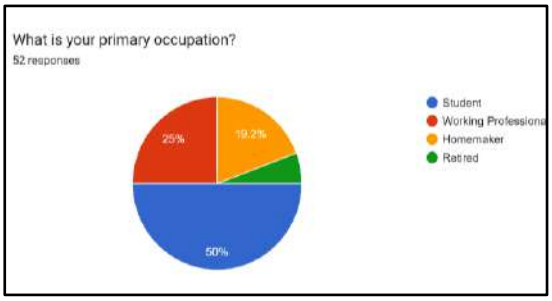
Chart 1.1



Age Group: The majority of respondents were in the 18–24 age group (55.8%), reflecting the high proportion of students. A notable percentage fell into the 25–34 age group (19.2%), representing early-career professionals, having a busy lifestyle. Fewer respondents were under 18 (5.8%), 35–44 (15.4%), or 45+ (3.8%), indicating limited participation from teenagers, mid-career professionals, and older individuals.

Occupation

Chart 1.2



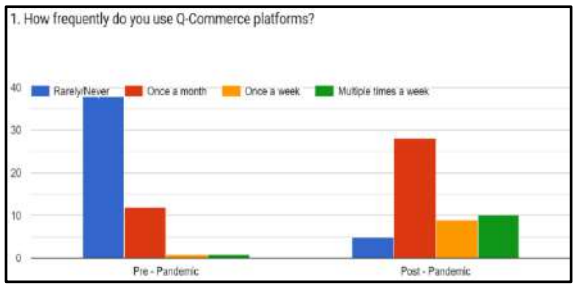
Primary Occupation: The majority of survey respondents were students (50%), indicating a significant representation from younger demographics, due to the survey being distributed in academic settings. This age group is more likely to embrace the convenience of Q-commerce platforms, as they often seek quick and easy solutions for their daily needs.

The second-largest group comprised working professionals (25%), who typically have demanded schedules and a busy lifestyle. For these individuals, the time-saving aspect of Q-commerce platforms makes them an appealing option. Smaller segments included homemakers (19.2%) and retired individuals (5.8%), both of whom tend to use Q-commerce primarily for convenience. The impact of Covid-19 likely influenced these groups, as the pandemic heightened the need for contactless, quick delivery services for essential items, which further contributed to the adoption of Q-commerce in these demographics.

Consumer Behaviour and Preferences in Quick Commerce

Frequency of using Q-Commerce Platforms

Chart 1.3



Pre-Pandemic: A large proportion of respondents (70%) used Q-Commerce platforms rarely or never, indicating that the platforms were not a significant part of their routine.

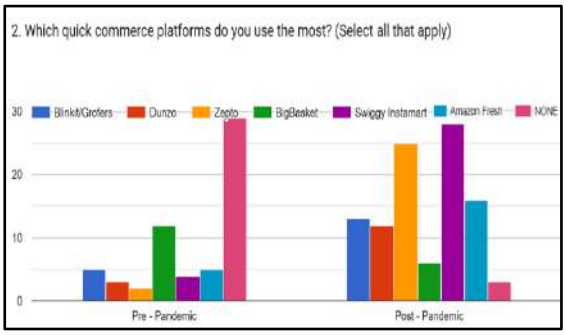
Post-Pandemic: The number of respondents using Q-Commerce platforms once a month increased from 12 to 28, reflecting a rise in occasional usage post-The frequency of use has also increased

among those using it once a week (from 1 to 9 respondents) and multiple times a week (from 1 to 10 respondents). This suggests that post-pandemic, more respondents are engaging with Q-Commerce platforms on a regular basis, possibly due to lifestyle changes and increased reliance on online services.

Interpretation: The pandemic normalized online shopping, with many consumers retaining this habit for safety and ease. Work-from-home lifestyles, urbanization, and expanded product ranges further boosted demand. Aggressive marketing, discounts, and loyalty programs have incentivized frequent purchases, while advancements in technology have made these platforms more reliable. Additionally, the preference for contactless delivery and the growing adoption of digital platforms across demographics have solidified q-commerce as a preferred choice for essentials.

Usage of Q-Commerce Platforms

Chart 1.4



Pre-Pandemic: The most popular platforms were Big Basket (12) and Blinkit/Grofers (5), with a majority (29) not using any Q-Commerce platform.

Post-Pandemic: There was a notable increase in usage across platforms, with Swiggy Instamart (28), Zepto (25), Amazon Fresh (16) and Dunzo (12) seeing the highest growth.

Interpretation: The data clearly shows a surge in the use of Q-Commerce platforms post-pandemic, with notable growth in platforms like **Swiggy Instamart** and **Zepto**, while **BigBasket** saw a decrease. The shift from "NONE" to using at least one Q-Commerce platform indicates a change in consumer behavior, likely driven by the convenience and necessity of quick deliveries during the pandemic.

Swiggy Instamart has become a leading Q-commerce platform by leveraging its established brand trust and loyalty from its food delivery service. Consumers appreciate the convenience of ordering groceries and meals through the same app, making it a go-to choose for multitasking. Swiggy's extensive delivery network ensures timely deliveries, even in smaller cities, while frequent promotions and discounts attract price-sensitive users.

Zepto stands out with its hyper-fast delivery model, promising essentials within 10 minutes. Its micro-warehouse strategy keeps inventory close to consumers, ensuring efficiency. Zepto's youthful branding appeals to Gen Z and millennials, while its focus on daily essentials targets a niche audience effectively. Advanced technology for route optimization and inventory management enhances its reliability.

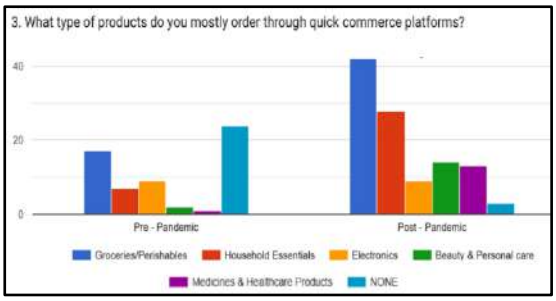
Blinkit (formerly Grofers) utilizes its pre-pandemic expertise in grocery delivery and competitive pricing to attract customers. **Dunzo** offers versatility with its delivery services for groceries, medicines, and essentials, coupled with real-time tracking and a strong presence in metro cities, catering to diverse needs.

Before the pandemic, **BigBasket** thrived with its focus on bulk orders and scheduled deliveries. However, the surge in demand for instant delivery during the pandemic caught it off guard, while others recently it launched *BB Now* for 30-minute deliveries,

leveraging its supply chain and product variety to compete in the Q-commerce space.

Product mostly ordered through Q-Commerce

Chart 1.5



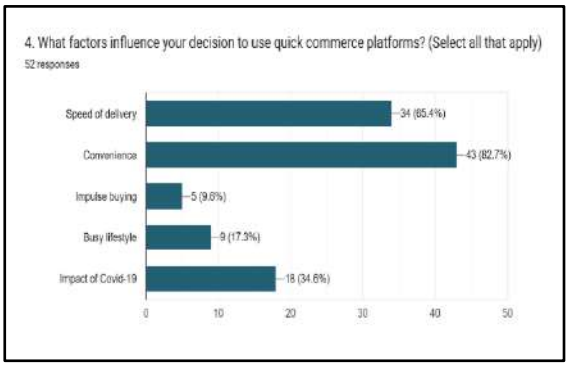
Pre-Pandemic: Most respondents ordered groceries/perishables (17), followed by electronics (9), and household essentials (7).

Post-Pandemic: There was a significant increase in the ordering of groceries/perishables (42), household essentials (28), and medicines & healthcare products (13).

Interpretation: The post-pandemic period saw a surge in the demand for groceries and household essentials, highlighting the growing reliance on Q-Commerce for everyday products, while electronics remained a stable but less popular category.

Factors influencing the usage of Q-Commerce

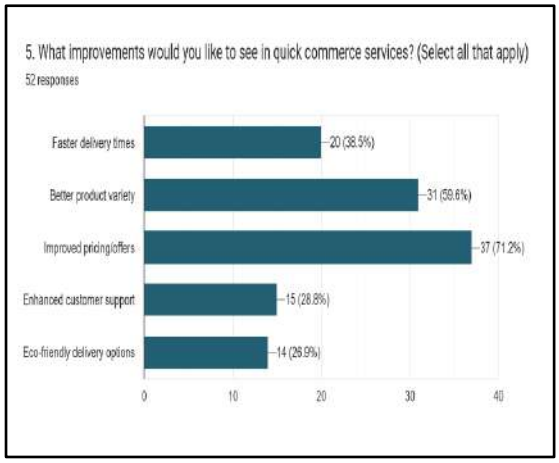
Chart 1.6



Interpretation: The primary factors driving the use of Q-Commerce platforms are convenience, speed of delivery, and the impact of Covid-19. These factors motivate most users, as they seek easy, fast access to products, especially during the pandemic. While impulse buying and a busy lifestyle are less significant, they still contribute to the appeal of Q-Commerce, offering convenience for spontaneous purchases and time-saving benefits for busy individuals.

Factors to be improved in Q-Commerce

Chart 1.7



Most Desired Improvements: Improved pricing/offers (37) and better product variety (31) were the top desired improvements.

Interpretation: Consumers are primarily seeking better value through competitive pricing and a wider range of products. Speed and customer support are important, while eco-friendly options are a secondary concern.

This chapter presented the key findings in the areas of usage trends, platform popularity, product preferences, and areas for improvement. It highlighted the growth in Q-Commerce usage following the pandemic, the rise of platforms such as Swiggy Instamart and Zepto, the shift in product preferences towards groceries, medicines, and beauty items, and the increasing demand for better pricing, a wider range of products, faster delivery, - of the post-pandemic environment, this study on consumer behavior in the era of Quick Commerce (Q-Commerce) has offered

insightful information about how customer preferences and usage patterns are changing. Significant trends and changes in how individuals use Q-Commerce platforms are shown by the analysis of survey results, underscoring the growing significance of speed and ease in influencing customer choices.

Usage Trends: The study's most noteworthy conclusion is the significant rise in Q-Commerce platform usage following the epidemic. Because of its speed and ease, consumers are increasingly more likely to use these platforms.

Online buying and delivery services gained popularity during the pandemic, and Q-Commerce became the go-to alternative for urgent requirements. This transformation reflects a long-term shift in customer behaviour, where accessibility and quickness have become critical factors.

Popular Platforms: Following the epidemic, Swiggy Instamart, and Zepto experienced the biggest increases in popularity among the several Q-Commerce platforms. These platforms have effectively drawn in customers by providing a large selection of goods and quick delivery services. Their success demonstrates the rising need for dependable, prompt, and effective services, which are now important considerations for many customers when selecting a platform.

Product Preferences: A noticeable change in the kinds of goods purchased via Q-Commerce platforms was also identified by the study. Prior to the pandemic, groceries and necessities for the home were the most often ordered products. Nonetheless, the demand for medications and cosmetics increased noticeably after the epidemic, which was indicative of broader shifts in consumer demands. Customers are using Q-Commerce platforms to have quick access to these necessary products as health and wellbeing become a higher priority.

Improvement Needs: Customers have identified a number of areas for development, notwithstanding Q-Commerce's expansion and success. The most often stated needs were better pricing and a greater range of products, indicating that although convenience is important, customers also want competitive pricing and a larger range of options. Faster delivery times are also in demand, as they continue to be crucial for preserving client happiness. An increasing awareness of sustainability issues in the context of fast delivery services is indicated by certain customers' interest in eco-friendly delivery solutions.

It is advised that attempts be made to broaden Quick Commerce's reach to more places as it develops further. More people will be able to take advantage of Q-Commerce's quickness and convenience if its services are made available in more places. In addition to serving metropolitan areas, this expansion would include suburban and rural areas, giving more customers access to speedy delivery services. Q-Commerce's potential for growth and effect will be greatly increased as more people adopt its convenience, opening up new markets and enabling companies to satisfy the rising demand for quick, easily available services.

To sum up, this study offers a thorough grasp of how consumer behaviour has changed in response to the emergence of Q-Commerce, especially in the years after the pandemic. The results indicate that Q-Commerce, which is motivated by the need for accessibility, speed, and convenience, is a substantial change in consumer buying patterns rather than merely a passing trend. In order to satisfy the changing needs of

their clientele, companies must give priority to these elements as the market expands while simultaneously addressing areas that require development.

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CHANGING CONSUMER PREFERENCES IN THE AGE OF INSTANT GRATITUDE

Dhanya Sree M, Karnika A, Shubhashree S

ABSTRACT

In the era of digitalization, understanding consumer behaviour has become paramount for effecting marketing and growth and expansion of any business. Approach of consumer behaviour towards E-marketing in multifaceted. Digital consumers are now more aware, informed, connected and empowered than ever before. The way a consumer discovers, evaluates and buy goods or services has been reshaped by proliferation of online platforms, social media and E-commerce. Marketers need to grasp the nuances of this contemporary behaviour of customers. Furthermore, the abstract emphasizes the role of technology in fostering consumerism, demand for instant gratification and personalized interactions and customization has been created by introducing technology. Consumers seek convenience, authenticity, quality and value which has encouraged the online businesses. This has increased the role of digital platforms in research comparison, data analysis and purchased decisions. This study gives the idea of changing the dynamics of consumerism in the digital age. Due to advanced and convenient technology, consumers are more attracting towards online shopping or E-commerce than offline shopping or retail marketing. This study also focuses on increasing use of digital platforms which include multiple choices of promotion or advertisement
that shape consumer preferences and encourage
their impulse buying behaviour. Not only the society but also the community as a whole get effected by contemporary consumerism. This study also explores the opportunities and problems that consumers of civil society face. They play a crucial role in growth of national economy.

KEYWORDS:

Consumerism, E- Commerce, technology, digital, Consumer behaviour, Customization.

INTRODUCTION

Clicks and Cartwheels: India's E-Commerce Odyssey in the Digital Age

India's e-commerce industry has grown at an unparalleled rate in the last ten years due to consumer desire for convenience and technology developments. This expansion has been made possible by a number of factors, including the widespread availability of reasonably priced cell phones, better internet connectivity, and supportive government regulations. The digital commerce ecosystem has been further strengthened by notable government programs including the Open Network for Digital Commerce (ONDC), the extension of BharatNet broadband, and the promotion of digital payment systems like Rupay and UPI. Because of this, traditional shopping habits have changed significantly, particularly in cities where people are choosing the ease of app-based buying over going to physical stores.

The COVID-19 Pandemic served as a driving force for this change. Customers were forced to switch to online shopping for necessities as a result of social distancing norms and strict lockdowns that disrupted traditional shops. Online transactions have shifted to emphasis on groceries and perishables, which were formerly bought from supermarkets or kirana (local) stores. In 2020, online grocery sales reached an 80% increase. Deferred deliveries gave way to instant fulfilment models as consumers started to value solutions that saved them time and aggravation.

The Rise of Quick Commerce in the Instant Gratification Era

Quick commerce, or Q-commerce, has become the e-commerce industry's next big thing, meeting the increased demand from consumers for quick delivery of necessities like daily-use goods, food, and medications. This change is in line with the hectic schedules, small living quarters, and convenience demands of contemporary urban lifestyles. Q-commerce offers deliveries in as low as 10 minutes, pushing the boundaries of client pleasure in contrast to regular e-commerce, which usually runs on delivery timetables of one to several days.

Q-commerce's expansion has been propelled by both new and established firms. Major platforms like Swiggy, Instamart, and BigBasket have expanded into this market to increase their reach, while startups like Zepto and Blinkit have created creative models especially suited for quick delivery.

The industry is expanding at an exponential rate; between FY 2022 and FY 2027, the predicted CAGR is 27.9%. It is anticipated to make a substantial contribution to the Indian online grocery market, with fast commerce predicted to hold 40–50% of the market in the upcoming years.

Speeding ahead: The Perks of Quick Commerce

Q-commerce offers numerous retail operating

advantages that boost customer satisfaction and enhance business operations. Taking advantage of this trend, companies like Swiggy, Instamart, and BigBasket provide delivery in major cities in as little as 45 minutes.

Redefining Convenience at Lightning Speed

Quick delivery of required products is the primary characteristic of q-commerce. It also provides a variety of possibilities and lowers warehouse rents. For everyday need, this convenience is advantageous. Q-commerce is therefore the greatest choice for pressing requirements.

Customers can use mobile apps to track their orders in real time. These platforms accept a number of payment options, such as cash on delivery, mobile wallets, and credit/debit cards. Customers can shop and receive deliveries at any time.

Racing against time

Products are guaranteed to arrive within minutes. This directly satisfies the contemporary need for speedy outcomes. This is ideal for urgent requirements or last-minute purchases.

It's frequently handier than visiting a store and quicker than conventional online buying. This implies that customers don't have to schedule their purchases or be concerned about running out of necessities.

Hyperlocal Logistics

Local logistics networks are utilized by Hyperlocal Logistics Q-commerce. As a result, it can complete orders from tiny centres or neighbouring shops. As a result, delivery times are shortened and process efficiency is increased.

OBJECTIVE

"Changing Consumer Preferences in the Era of Instant Gratification" seeks to investigate how quick commerce platforms are being shaped by rapidly changing consumer behaviour, which is fuelled by growing demands for convenience, personalization, and advantageous financial policies. This study will assess important factors influencing platform usage, satisfaction, and loyalty, based on the hypothesis that elements like low effort, quick delivery, customized experiences, and cost-related incentives have a

significant impact on consumer preferences. By analysing the convergence of convenience, personalization, user experience, and cost-related benefits, the research attempts to find trends that will help businesses optimize their offers and better fulfil customer needs in a fast-paced digital economy.

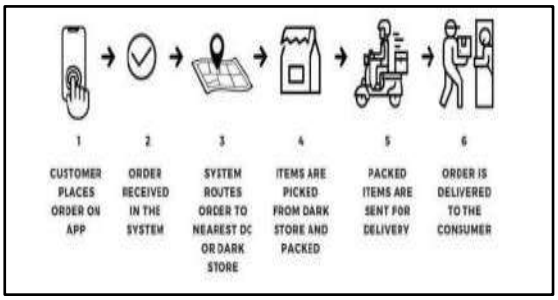


Fig 1

REVIEW OF LITERATURE

Hassan and Lahore (2023) had explored a comprehensive analysis of consumer behaviour in the digital age. The objectives of the study are to contribute to a deeper understanding of the dynamic interplay between consumers and the digital environment and to provide insights into the factors shaping consumer behaviour in the digital age. This study draws on a synthesis of academic literature, empirical studies, and industry reports. The result of the study highlights the significance of personalization, social media, and emerging technologies in shaping consumer experiences and decision-making processes in the digital age. The author suggested that businesses should adapt to evolving trends, leverage digital technologies, and prioritize ethical considerations in order to understand consumer behaviour in the digital age.

Sanchez (2024) examined the components that influence consumer purchasing behaviour on quick commerce platforms. The objective of this study is to understand the role of interaction quality, interface quality and information quality in shaping consumer decisions. This study used a mixed-methods approach, combining both qualitative and quantitative data collection and analysis methods. The study finds that technology acceptance factors, including perceived usefulness and perceived ease of use, along with mobile service quality factors such as interface quality and information quality, are closely linked to consumer purchasing behaviour. The author suggested to use the study's findings to improve their strategies and platform features. And the author also suggested the future research should include demographic factors and explore the role of user satisfaction, loyalty and trust.

Karbasivar and Yarahmadi (2011) had examined the relationship between consumer's apparel impulse buying behaviour and four external factors: Credit card, promotional approaches (cash discount and free product) and in-store form display. This study used a survey methodology with 280 questionnaires distributed among shoppers at central market. The study found a positive and pivotal relationship between consumer impulse buying behaviour and four external factors. The author suggests to install ATMs in their shops and inform consumers of their availability, offer complementary products as gifts to stimulate impulse purchases and to modernize their stores. Since this study investigates only about the impulse buying for apparel products with low involvement, future research could investigate impulse buying for high involvement products.

Singh and Tomar (2024) analysed how satisfied customers were using Quick Commerce platforms in Thane City as opposed to traditional retail establishments, and convenience affect customer choices. The results show that Q-commerce

platforms are generally thought to be speedier and more convenient, with 58% praising their convenience and 69% favouring their speed. According to the Mann-Whitney U Test, which verified a substantial difference in happiness between Q-commerce and traditional retail, Q-commerce consumers had noticeably higher satisfaction levels. The study demonstrates the main elements influencing consumer choices and provides concrete recommendations for raising customer satisfaction and engagement in the Q-commerce industry. It emphasizes the significance it is that businesses to implement customer-focused tactics and technical advancements in order to maintain competitive advantages in the changing retail landscape.

Ganapathy and Gupta (2023) explores consumer behaviour and market dynamics in the quick commerce (Q-commerce) grocery delivery sector in India, emphasizing the importance of dark stores, efficient logistics, and customer-centric services for success. The sector's growth is driven by convenience, speed, and cost, but only 3% of consumers are prepared to pay a delivery fee for 30-minute deliveries, according to key results.

Platforms such as Swiggy Instamart dominate the market, and consumer preferences are heavily influenced by value, freshness, and promotional offers. But issues like supply chain management, high operating expenses, and the requirement for alternate sources of income continue to be crucial. In accordance to the study, Q-commerce is expected to develop significantly over the next three years, reaching $70 billion, but maintaining this growth would require strategic investments, cost management, and partnerships with local grocery stores to enhance profitability and scalability.

Goswami and Kumari (2024) investigate how fast commerce affects customer decision-making, emphasizing the effects of speed, convenience, and instant delivery services on impulsiveness, contentment, and buying patterns across a range of demographics. The study reveals no discernible effect on the overall decision-making process, with purchasing decisions still being influenced by a number of factors, even though rapid commerce improves consumer engagement through tactics that highlight delivery speed and promotions. These findings provide useful information for companies and legislators looking to successfully handle consumer psychology and engagement tactics while adjusting to the quickly changing landscape of digital commerce.

RESEARCH METHODOLOGY

Introduction

Research Methodology is a systematic way to solve the research problem. The research Methodology places an important step in any research study. It may be understood as a science of studying how research is done scientifically. The methodology used for the study is structured into different categories like data extraction, data grouping, and statistical techniques and tools for analysis.

Research Design

Research design is a logical and systematic plan prepared for directing a study. This is a blueprint which depicts the outline of how an investigation will take place. The research design used for this study

TABLE 1
RESEARCH METHODOLOGY

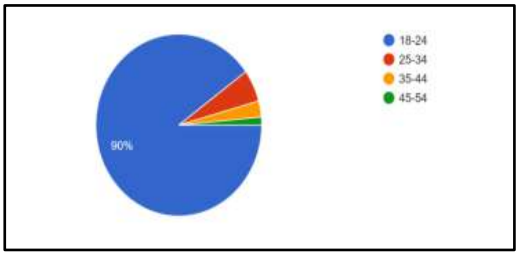
DESCRIBER	DESCRIPTION

Software used	Microsoft Excel
Data collection	Primary data – Questionnaire
Target population	Users of Quick Commerce platforms
Data representation	Pie charts and table
Analysis technique	Correlation analysis

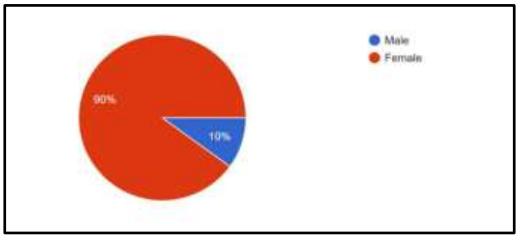
DATA ANALYSIS AND INTERPRETATION

Demographics

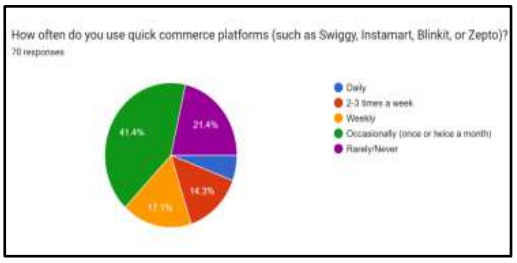
Age group

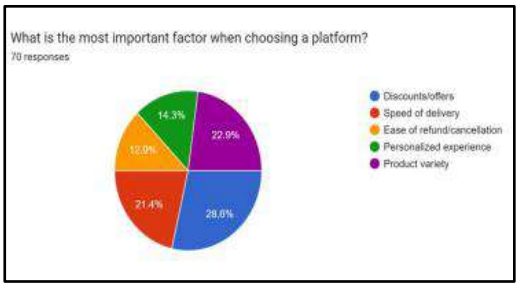


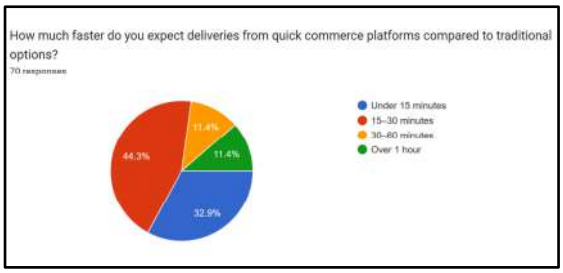
Gender



Usage Patterns







CORRELATION ANALYSIS

H1: Convenience and Frequency of Usage

Particulars	Convenience score	Movement less shopping	Time saving	Emergencies	Frequency score
Convenience score	1.00	0.78	0.80	0.77	0.13
Movement less shopping		1.00	0.41	0.43	0.03
Time saving			1.00	0.44	0.06
Emergencies				1.00	0.22
Frequency score					1.00

FINDINGS

Convenience Score Analysis

Movement-less shopping (0.78), time saving (0.80), and emergencies (0.77) are the three main factors that have a strong correlation with the Convenience Score. These substantial connections imply that consumers view convenience as a mix of these three components rather than as being dominated by a single feature. Platforms that save time, successfully handle emergency situations, and offer seamless shopping experiences with no physical exertion are seen as more convenient.

Relationship Between Convenience and Usage Frequency

The Convenience Score and Frequency Score have a weak association (0.13), suggesting that although convenience parameters together influence how convenient a platform is perceived, they do not significantly influence how frequently it is used. Emergencies has the highest correlation (0.22) with usage frequency among individual convenience variables, indicating that customers are somewhat more inclined to use rapid commerce platforms for urgent, emergency-driven demands. However, the correlations between frequency and Time Saving (0.06) and Movement-less Shopping (0.03) are

much smaller, suggesting that these factors by themselves are not strong enough to encourage frequent platform use.

Interdependence Between Convenience Factors

The convenience criteria are slightly dependent on one another. The moderate association (0.41) between movement-less shopping and time savings suggests that customers frequently combine both advantages. Likewise, there is a moderate correlation between Emergencies and Time Saving (0.44) and Movement-less Shopping (0.43). Platforms that succeed in one area of ease are probably thought to excel in other areas as well, according to this overlap. These correlations, however, do not hold true for Frequency Score, indicating that the overall impression of convenience does not entirely correspond to higher platform utilization.

H2: Personalization and User Experience

Particulars	Personalized recommendation	Customization	Personalisation score	Diversified options	App design	Satisfaction score
Personalized recommendation	1	0.55	0.88			
Customization		1	0.88			
Personalisation score			1			
Diversified options				1	0.60	0.89
App design					1	0.90
Satisfaction score						1

FINDINGS:

Personalization and Satisfaction

Customization (0.72) and Personalized Recommendations (0.76) have a good correlation with the Personalization Score. This suggests that users define personalization as the capacity of platforms to customize recommendations as well as the ability of users to personalize their experiences. These elements also have a positive correlation with contentment Score (e.g., 0.68 for Customization and 0.64 for Personalized Recommendations), indicating that platforms that provide individualized and configurable experiences greatly raise consumer contentment.

User Experience and Retention

App Design (0.75) and Diversified Options (0.71) have a substantial correlation with the Satisfaction Score, suggesting that a user-friendly interface and a large selection of options are important factors that influence satisfaction. Additionally, there is a substantial positive association between satisfaction and retention (0.82), indicating that happy customers are more inclined to stick with the platform and choose it over rivals. This implies that long-term customer involvement is facilitated by a smooth and fulfilling user experience.

Interdependence Between Factors

A considerable degree of dependency exists between User Experience Elements (e.g., App Design and Diversified Options: 0.67) and Personalization Factors (e.g., Personalized Recommendations and Customization: 0.58). These connections suggest that platforms that perform well in one area are probably thought to be doing well in another. To increase satisfaction and retention, however, personalization and user experience must complement one another.

H3: Cost and Policy

Particulars	Financial incentive score	Discounts	Wallet payments	Trust and loyalty score	Refund trust	Loyalty
Financial incentive score	1	0.76	0.80	0.64	0.58	0.55
Discounts		1	0.72	0.52	0.55	0.50
Wallet payments			1	0.48	0.55	0.56
Trust and loyalty score				1	0.83	0.811
Refund trust					1	0.35
Loyalty						1

FINDINGS:

Financial Incentives and Trust

Wallet Payments (0.80) and Discounts (0.76) have a good correlation with the Financial Incentive Score. This indicates that while using rapid commerce systems, consumers view financial rewards as a major advantage. Additionally, there is a moderately positive association between financial incentives and the Trust and Loyalty Score (0.64), suggesting that users

are more inclined to trust and remain loyal to platforms that provide real cash rewards.

Policies and Trust

The Trust and Loyalty Scores (0.83 and 0.81, respectively) have a substantial correlation with Refund Trust and Loyalty, highlighting the significance of fair and transparent refund and cancellation policies in fostering trust. Furthermore, there is a moderate correlation between Refund Trust and Financial Incentive Score (0.50), indicating that clear policies and financial incentives strengthen loyalty and trust.

Interdependence Between Factors

The correlation matrix shows that the elements of trust and loyalty are highly dependent on one another. For instance, loyalty has a moderate correlation with both discounts (0.56) and refund trust (0.55), indicating that both financial gains and policy dependability influence customer loyalty. This dependency suggests that customer trust may be increased by a comprehensive strategy that combines financial incentives and open policy.

LIMITATIONS:

Limited Demographic Diversity: The study predominantly focuses on urban users of quick commerce platforms. Limited attention is given to rural demographics or non-users. Lacks exploration of varying income groups and their engagement with Q commerce.

Narrow Product Scope: Focuses mainly on groceries and daily necessities, with limited insights into high-involvement or luxury products. Impulse buying behaviour for other product categories remains unexplored**.**

Temporal Constraints: Study data is based on a specific timeframe, which may not account for seasonal variations or long-term trends.

Platform-Specific Bias: Heavily reliant on data from leading platforms like Swiggy, Instamart and Blinkit, limiting insights into smaller or emerging platforms.

Lack of Behavioural Analysis: Minimal exploration of psychological factors, such as trust-building mechanisms and consumer loyalty over time.

Policy and Cost Impact: Limited investigation into how cost structures (delivery fees, subscription models) and policy changes impact consumer preferences.

CONCLUSION

The research paper indicates that digital consumerism has fundamentally transformed consumer preferences, underlining the increased importance of convenience, personalization, and rapid commerce (Q-commerce) in driving purchasing behaviour. The study highlights how current technology and digital platforms have enabled customers to make informed, real-time decisions while stressing speed and simplicity of access. According to key findings, customer happiness is greatly influenced by convenience features including time savings, emergency responsiveness, and movement-free shopping. Enhancing consumer engagement requires personalization, which includes customized experiences and recommendations. Furthermore, monetary rewards and open policies foster customer loyalty and confidence. All things considered, the survey emphasizes how e-commerce and Q-commerce have revolutionized consumer expectations and purchasing behaviours. Additionally, it highlights how important it is for companies to implement customer-centric strategies, use cutting-issues to maintain expansion in the changing digital economy.

SUGGESTIONS & RECOMMENDATIONS:

Broader Demographic Coverage: Include rural and semi-urban populations to understand how Q-commerce penetrates less developed markets. Study behavioural differences across income and education levels.

Exploration of High-Involvement Products: Investigate consumer behaviour for luxury or high-value items within the Q-commerce model. Examine how impulse buying varies with higher stakes.

Longitudinal Studies: Conduct research over extended periods to observe evolving consumer preferences and seasonal trends. Study the sustainability of consumer loyalty to Q-commerce platforms over time.

Diversity in Platform Analysis: Assess the performance and consumer perception of smaller or niche platforms. Compare regional and global Q-commerce trends.

Integration of Psychological Factors: Explore the role of trust, perceived value, and emotional satisfaction in driving consumer loyalty. Analyse the impact of personalization on long-term engagement.

Cost and Policy Dynamics: Investigate the effects of pricing models, subscription options, and flexible policies on user retention. Study consumer response to regulatory changes in e-commerce and Q-commerce sectors.

Technology Adoption: Examine the impact of emerging technologies like AI and blockchain on Q-commerce. Assess how tech innovations can further enhance speed, personalization, and user experience.

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QUICK COMMERCE THROUGH THE CONSUMER LENS: DECODING CONSUMER PREFERENCES

Ananya Anand, Pratibha Sundarraman

ABSTRACT

In today's fast - paced lifestyle where consumers seek time - saving solutions, Quick Commerce (Q-Commerce) has transformed the way consumers shop for daily essentials, offering ultra-fast deliveries and unmatched convenience. This research explores the consumer mindset to understand the key factors influencing their choice of Q-Commerce platforms. The study focuses on priorities such as delivery speed, pricing, packaging quality, sourcing transparency, trust, user experience, and the freshness and overall quality of products. Additionally, it compares various Q-Commerce players, examining dimensions such as service efficiency, platform usability, and overall value proposition. The findings aim to uncover consumer preferences and highlight the reasons behind the success of certain platforms over others.

While the study seeks to understand consumer decision-making, it also aims to provide actionable insights for Q-Commerce players. These insights will help businesses better align their services with consumer expectations, focusing on areas that matter most to their users. By refining operational strategies and enhancing customer satisfaction, Q-Commerce platforms can foster long term loyalty and achieve sustained growth in this rapidly evolving sector.

KEYWORDS:

Quick Commerce, Consumer Behaviour, Consumer preferences, Consumer satisfaction, Brand value proposition.

INTRODUCTION

The field of digital commerce has rapidly evolved and once again the industry is seeing a shift faster than anyone could have predicted and this time it's in Quick Commerce (Q-Commerce). This disruption is now emerging and it is revolutionizing the shopping of daily essentials at never seen before speed and ease. Q-commerce platforms like Zepto, Blinkit and Dunzo have emerged as frontrunners and enablers of this revolution strengthening consumer trends and standards. It is very important in this regard to find out how and what decisions are made and how customers' satisfaction is affected on the Q-Commerce platforms for those enterprises which aim to succeed in this developing market stream.

This paper explores the data relating to buying behaviour of consumers in Q-Commerce environment and analyses key drivers like delivery time, product quality and perceived convenience. This way the study offers recommendations that organisations could consider to enable them to match their services more aptly to the expectations of the customers so as to ensure that they gain their loyalty in the long-run. This research aims at establishing how Q-commerce platforms perceive and impact the customer perceived value through the value propositions of service quality. Thus, the study is intended to make useful recommendations to businesses in the Q-Commerce field by evaluating how well the platforms meet customers' needs and expectations and by highlighting existing gaps that require strategic action.

Research Need

Examining Q-commerce through consumer perspective is important to understand the impact of these market solutions on purchase decision-making, customer satisfaction, and loyalty. A study of the expectations of consumers and issues that customers face is necessary for various

firms that look to enhance the quality of the value proposition of offers, address inefficiencies, and ensure sustainability in the fast-growing market. Market understanding helps in closing the gap of service delivery and user requirement which enhances the usage of Q-commerce platforms.

Research Objectives

Understand Consumer Preferences: To examine the factors that influence consumers' choices in Q-Commerce, focusing on delivery quality and speed, pricing, and convenience.

Analyse Consumer Behaviour: Conduct a study on the behaviour of consumers towards the Q-Commerce services, with specific emphasis on consumer decision making factors, expectations, preferences and unmet needs.

Provide Business Insights: In an effort to offer a thorough evaluation of the current state and emerging trends in Q-Commerce platforms, as well as to offer findings that might help such platforms meet the consumers' needs and expectations and satisfy their customers and stakeholders, thus ensuring the ongoing survival and growth in a rapidly evolving industry.

Research Gap

The research gap for this study is that there is limited insight into the consumer experiences, expectations, preferences, and barriers in the Quick Commerce (Q-Commerce) market. However, despite the growing number of papers that address various aspects of Q-Commerce, there is limited investigation of the topic that addresses customer concerns straight. Knowledge of consumers' behaviour when they interact with Q-Commerce platforms, the drivers of these actions, and barriers that they face when using such services is fairly limited. This study aims at filling the above shortcomings by obtaining useful information from consumers, focusing on their actual experiences, and shedding light on what is relevant in the ever-evolving Q-Commerce environment.

REVIEW OF LITERATURE

Goswami, A., & Kumari, R. had explored the rapid delivery of products as the subject of impact on consumer decision making. In the opinion of the authors, convenience and speed of quick commerce led to strong influence on customers wherein customers' decision-making time is reduced, impulse buying takes place, and pleasure level is high. The research looks at how the nature of these services influences the 'purchase encounter' and established indicators of consumer interaction, from the users' psychological and emotional perspectives. Ultimately, the authors are able to conclude that, although rapid commerce does influence aspects of consumer behaviour it does not eliminate decision making methodologies.

Dr. Chithambar Gupta and Venkatesh Ganapathy (2023): The need for satisfaction and technology adoption factors relevant to Quick Commerce grocery delivery in the Indian context are established as successful performance indicators in this exploratory analysis. In the process of talking about needs it proceeds to financing, controlling the costs and profitability after pandemic. The research focuses on the aspects of OE and IDR as essential factors for the sustainability of the Quick Commerce industry.

Kalpana, P., & Thilagavathy, N. had explored the different aspects of consumer preferences towards attitudes in online shopping have been discussed in the study titled, detailing out the factor that shape consumer preferences such as number of

products available, affordable prices, and ease of use. This proves that 65% of the participants are motivated by discounts whereas 78% of the participants like the option of choosing shopping online. But some factors that negatively affect confidence and pleasure are quality (70%) and privacy (62%). The research uses both qualitative and quantitative data collection techniques and samples different age groups presenting those younger consumers value convenience while older one's value security and quality. Solving these problems can enhance the totality of online buying experience and boost the level of clients' loyalty.

Singh, R. R., & Tomar, V. R. had included findings from a number of research endeavours. The publication also demonstrates how Q-commerce is changing the clients' habits and stresses how crucial convenience and delivery time are. According to prior studies, Q-commerce is more advantageous than traditional shopping, this is due to the fact of, consumers are putting most value in convenience and speed. Consumers are getting choosy with their demands and place high premium on quality and speed. Certain forms of qualitative information about localized customers' engagement with Thane City's Q-commerce are still missing, which necessitates fragmented quantitative studies to help firms understand these dynamics more effectively and make decisions in this rapidly evolving Q-commerce sector.

Mayukh Mukhopadhyay et.al had stated that the COVID-19 pandemic forced a disruption of global retail Since consumers could not venture out during the period, industries had to re-strategize. He talked on how through fast commerce for the next evolution in online shopping clients could get goods through businesses faster and more conveniently. During the shutdown, most customers relied on e-grocery portals to buy groceries from clean environment with no contact to others.

Chavhan, R., & Dutta, P. (2024) had integrated findings from extensive research to address the challenges of sustainability, resource efficiency, and scalability in quick commerce food supply chains (q-grocery FSFSCs). It highlights the importance of incorporating circular economy (CE) practices to enhance supply chain resilience and promote sustainable livelihoods. The study underscores the critical role of CE practices, particularly waste reduction, sustainable packaging, sustainable sourcing, route optimization, and customer convenience, in creating a significant positive impact on sustainability dimensions. Medium-impact strategies, including energy efficiency, sustainable fleet usage, resale and redistribution, and improved information flow, further support supply chain improvements. Despite these advancements, certain practices, such as composting, reverse logistics, and appropriate storage, show lower impacts, indicating areas for further development. This research emphasizes the need for a holistic approach to integrating high-impact CE practices for scalable and sustainable last-mile operations in q-grocery FSFSCs.

RESEARCH METHODOLOGY

Research Design

The study adopted a mixed-methods approach, integrating primary and secondary research to gain a comprehensive understanding of the impact of Q-commerce on consumer decision-making and satisfaction levels.

Data Collection Methods

Primary data was collected from 75 respondents through structured questions

created using Google Forms. Survey sampling was employed to ensure relevance to the study objectives, targeting individuals familiar with Q-commerce platforms. The survey included both closed-ended and Likert-scale questions to analyse factors such as service quality, customer satisfaction, and consumer expectations. Secondary data was obtained from publications, research papers, market research reports and newspaper articles to contextualize and validate the primary findings.

Scope of Analysis

The study focuses on:

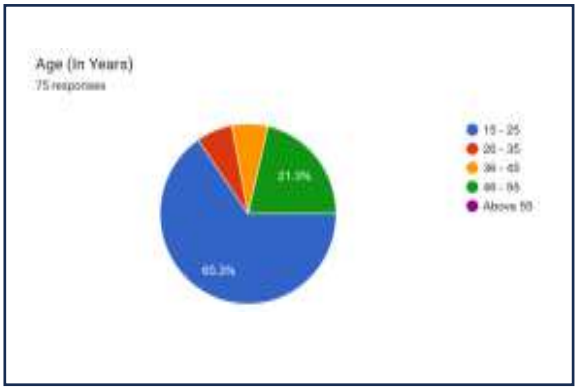
1. Evaluating the overall value propositions of Q-commerce platforms.
2. Assessing how well these platforms met consumer demands and expectations.
3. Identifying common bottlenecks experienced by users.

Limitations of Analysis

The study's reliance on a small sample size (75 respondents) restricts the wide applicability of such data collected. Additional research with a larger and more diverse sample could provide deeper and more representative insights.

Age of Respondents

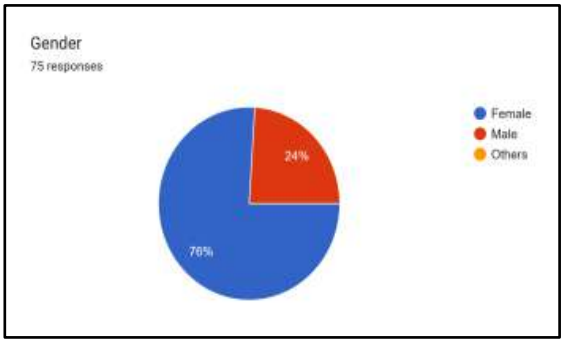
Chart 1.1



The majority of respondents were aged between 15 and 25, while approximately 35% fell within the 26 to 55 age group.

Gender of Respondents

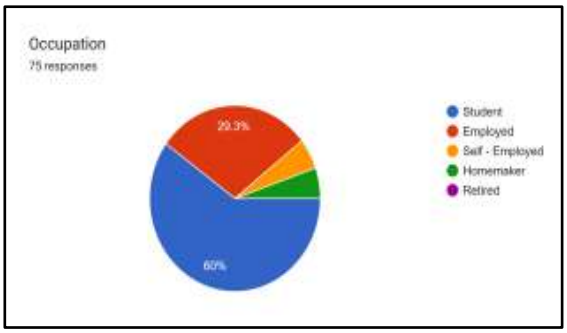
Chart 1.2



Around 76% of the respondents were females while the remaining 24% were males.

Occupation of Respondents

Chart 1.3

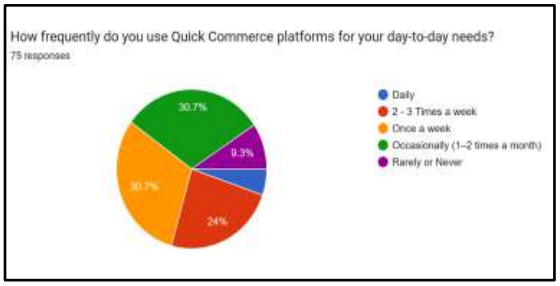


The survey respondents are predominantly students, making up 60% of the total participants. Employed individuals form the second-largest group, accounting for 29.3% of the respondents. Self-employed individuals and homemakers represent smaller portions, with 5.3% and 4%, respectively. Retired individuals did not participate in the survey.

ANALYSIS & INTERPRETATION

Frequency of Use

Chart 1.4

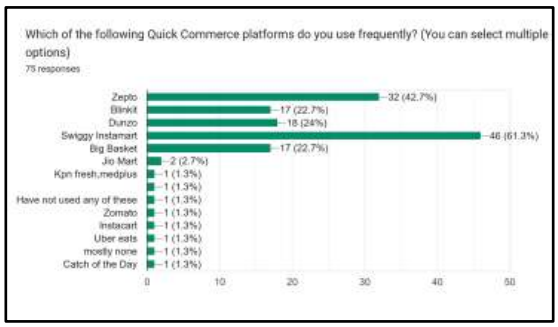


Occasionally (1–2 times a month) and once a week are the most common usage

frequencies, each accounting for 30.7% of responses. 2–3 times a week usage follows with 24% of respondents. Daily usage is relatively low, with only 9.3% of respondents using quick commerce platforms every day. A small minority of respondent's report 'Rarely or Never' using these platforms.

Quick Commerce Platforms used by the Respondents

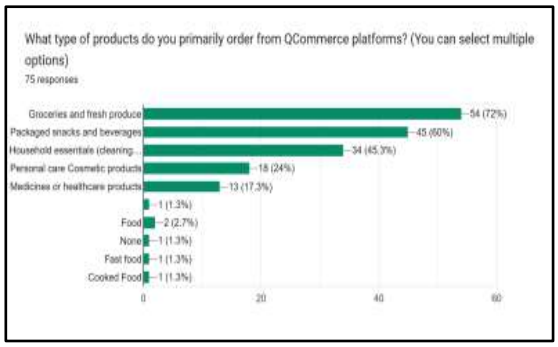
Chart 1.5



The poll shows Big Basket as the most used quick commerce platform (61.3%), followed by Zepto (42.7%) and Swiggy Instamart (24%). Platforms like Blinkit and Dunzo have moderate usage (22.7%), while others like Jio Mart and niche options are rarely used.

Type of Products ordered through the Q-Commerce Platforms

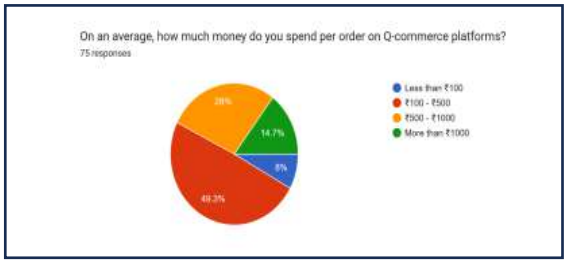
Chart 1.6



Groceries and fresh produce are the most ordered category, with 72% of respondents selecting this option. Packaged snacks and beverages follow, with 60% usage. Household essentials like cleaning supplies are ordered by 45.3% of respondents. Personal care and cosmetic products are less frequently ordered (24%), and medicines/healthcare products make up the smallest category (17.3%). Other categories like fast food and cooked food are almost negligible.

Money spent on Purchases through Quick Commerce Platforms

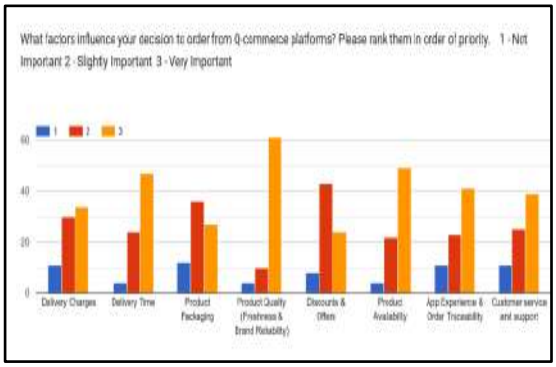
Chart 1.7



The poll reveals that nearly half (49.3%) of respondents spend ₹100–₹500 per order on Q-commerce platforms, making it the most common expenditure range. About 28% spend ₹500–₹1000, while 14.7% spend over ₹1000 per order. Only 8% of respondents spend less than ₹100, indicating that most users place higher-value orders.

Factors influencing Purchase Decisions

Chart 1.8

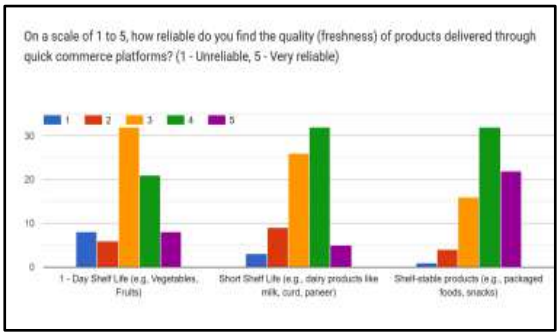


The chart shows that 57.3% of respondents rated product quality (freshness and brand reliability) as "Very Important," making it the most prioritized factor. Delivery time followed, with 49.3% marking it as "Very Important." Discounts and offers were also crucial for 40% of respondents. In comparison, product availability (37.3%), app experience (36%), and customer service (34.7%) were moderately

important, while only 28% considered delivery charges as "Very Important."

Reliability of Product Quality

Chart 1.9



The chart indicates that shelf-stable products like packaged foods are seen as the most reliable, with 46.7% of respondents rating them 5 (very reliable) and 32% rating them 4. Short shelf-life items, such as dairy, received mixed reliability scores, with 37.3% giving a 4 and 29.3% giving a 3. Day shelf-life products, like fruits and vegetables, were perceived as the least reliable, with 40% rating them 2(unreliable) and 29.3% giving a neutral score of 3.

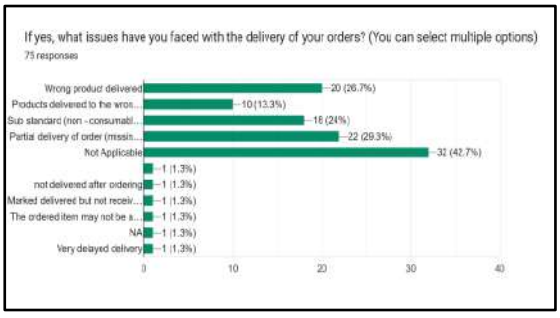
Issues relating to Delivery

Chart 1.10

Close to exactly half of the respondents have faced delivery related challenges.

Type of Issues faced

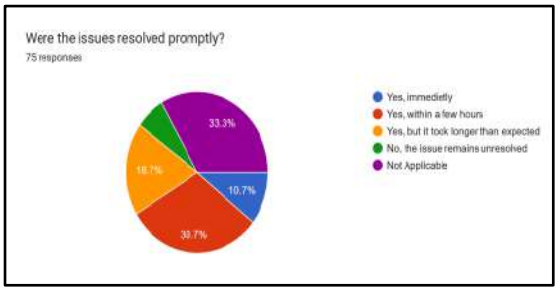
Chart 1.11



Among respondents who faced delivery issues, the most common problems were "Partial delivery of order" (29.3%), "Wrong product delivered" (26.7%), and "Substandard quality" (24%). Other issues like delivery to the wrong address, delays, or items not received were reported less frequently.

Solvency of Issues

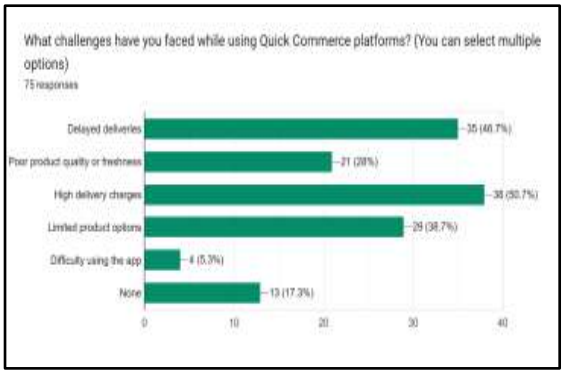
Chart 1.12



Among respondents who reported issues, 30.7% stated their problems were resolved within a few hours, and 10.7% experienced immediate resolution. However, 18.7% noted delays in resolution, and 6.7% said their issues remained unresolved. The majority (33.3%) selected "Not Applicable," indicating they faced no issues.

Challenges faced while using Quick Commerce Platforms

Chart 1.13

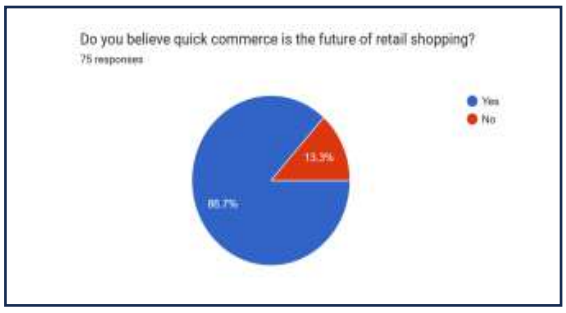


The chart reveals that 50.7% of respondents identified high delivery charges as a major challenge, making it the most reported issue. Delayed deliveries were the second most common problem, faced by 46.7% of users. Limited product options were a

concern for 38.7%, while 28% experienced poor product quality or freshness. Only 5.3% reported difficulties using the app, and 17.3% faced no challenges, indicating a satisfactory experience for a small segment of respondents.

Future of Retail Shopping

Chart 1.14



A significant majority of respondents, 86.7%, believe that quick commerce will be the future, while only 13.3% disagree. This suggests strong optimism about the potential of quick commerce to reshape the retail landscape.

FINDINGS AND SUGGESTIONS

Key Patterns Trends and Observation:

Consumer Preferences and Expectations

Focus on Essentials: Food items and other daily use products are most often ordered, underlining the function of Q-commerce as a convenient delivery service.

Value-Driven Behaviour: Consumers rank an array of features, from product quality to time to delivery, and discounts reflecting on the perceived value of products against their convenience.

Trust Issues with Perishables: Products with a short shelf-life such as fruits and vegetables or dairy are not trusted due to easy perishability and lack of assurance on the freshness of such perishables.

Challenges in the Ecosystem

High Delivery Costs and Delays: Delivery cost is a significant aspect which affects satisfaction since delivery fees and varying time of completion of deliveries are sensitive aspects.

Resolution Efficiency Needed: Efficient problem resolution is crucial, as promptly addressing consumer complaints builds trust in the product. However, delays in responding to complaints can weaken consumer confidence and satisfaction.

Positive Sentiment Towards Growth

Optimism About the Future: Most view Q-commerce as a necessary element of the retail mix as consumers demand efficiency and as their lifestyles change.

Suggestions / Recommendations to Quick Commerce Businesses

Enhancing Value Proposition

Optimize Pricing Strategies:

Introduce flexible delivery charge models, such as subscriptions for frequent users or free delivery for orders above a threshold.

Offer value packs or bundles tailored to customer preferences.

Reliability and Quality Assurance:

Reduce the acceptance quality of perishable items especially by establishing better quality checks.

Partner with local farmers and suppliers to ensure freshness and reliability.

Optimize the management of orders and improve the possibility of timely completion of deliveries, thereby minimising delivery issues.

Customer-Centric Innovations:

Provide in-app discounts and give them special privileges if the user has been with the app for a long time.

Utilize artificial intelligence to recommend products based on a consumer's previous purchase history, tracking the timeline of their purchases and suggesting items at appropriate intervals.

Operational Excellence

Streamline Logistics:

Fund micro-fulfilment centres that will offer faster deliveries.

Electrification of transportation through electric vehicles and bicycles to increase the cost-effectiveness of organizations.

Tech-Driven Enhancements:

Enhance the interactions between app users and the application since some aspects may be regarded as painful were designing new means for ease, for example, voice-based search.

Leverage on chatbots for quick clients' attending and quick handling of the complaints.

Scalability and Profitability

Expand Product Range:

They should be subcategories such as gourmet food, 'green' products and foods for particular diets.

Invite brands for special launches that can only be sold via the platform.

Target Underserved Markets:

On this note, there is a need to extend operations to tier-2 and tier-3 cities, reminiscent of affordability and gaining entry to eminent healthcare for majority households.

Community Engagement and Branding

Consumer Education and Trust Building:

Create posts sharing knowledge about supplies of products and advantages of the concept of quick commerce.

Encourage users taking part in self-generated campaigns as well feedback sessions.

Personalized Marketing:

Target specific marketing promotions based on data available.

Regarding user-specific promotions, platforms can include occasional events like birthdays or anniversary of registration dates and give special discounts.

Future Outlook

Rapid Market Growth

Rapid market growth is driven by the rising population of urban consumers, coupled with their more and more demanding schedules.

Web popularity and mobile phone applications give access to a greater number of consumers.

The Q-Commerce market is reported to grow at double digits CAGR in the coming years driven by convenience-oriented consumer trends.

Technological Development

Inventory system powered by the help of artificial intelligence for predicting stock gain and loss for less wastage.

Making use of drones, delivery vehicles that are self-driven, and robotics in order to enhance delivery services crafted expeditiously.

Actual identification and addressing of the consumer through data analysis to deliver customized real-time monitoring.

Hyper-Localization

State for micro-warehousing and dark stores when fulfilling orders in a particular locality.

Developing relationships with local suppliers and businesses to get up products relevant to local cultural preferences and trends.

Shortened delivery intervals, increasing the attractiveness of the service among those customers who are running short of time.

Increase in New Product Categories

Innovation, including diversification of product range from traditional food products to healthcare, electronics and luxury products. This can be done by

partnering with brands for first-party and exclusivity in last-mile delivery.

Rural Market Penetration

Capitalizing on the untapped opportunities in Tier 2 and Tier 3 cities can enable the platform to effectively meet the growing demand for its services in these regions, driving expansion and market penetration.

Increased transport network capacity which will make delivery in areas that have growth and yet are not as urban as the major cities, possible.

Stressors and Organizational Accommodations

Increased levels of competition may well translate into a tendency for cut-throat pricing, forcing management for better efficiencies.

Emphasis on the aspect of repeat patronage always by provision of loyalty incentives and excellent services.

Pricing strategy will remain majorly important as firms try to offer the service fast, cheap and profitable way.

CONCLUSION

In conclusion, the rapid evolution of Quick Commerce has undeniably reshaped the way consumers shop for daily essentials, setting new benchmarks for speed, convenience, and service quality. As Q-commerce platforms like Zepto, Blinkit, and Dunzo continue to redefine consumer expectations, this research underscores the importance of understanding the factors driving customer preferences, behaviour, and satisfaction.

The findings highlight that customers prioritize swift delivery, reliable product quality, competitive pricing, and user-friendly platforms. However, there remain areas where platforms can improve, such as addressing high delivery charges, ensuring consistent freshness of perishable items, and offering a broader product range. These gaps, if strategically addressed, could further strengthen customer loyalty and trust.

For businesses in the Q-commerce field, the journey ahead is both challenging and promising. By leveraging consumer insights to enhance service quality and address unmet needs, they can not only meet but exceed customer expectations, thereby securing a competitive edge. This research serves as a reminder that at the heart of every technological disruption are the people it seeks to serve—customers who value efficiency but also crave reliability and care in their shopping experiences.

Ultimately, the success of Q-commerce lies in its ability to balance innovation with human-centric service. Platforms that adapt to these evolving demands with agility and empathy will not only thrive in this dynamic market but also build lasting relationships with their customers, ensuring sustainable growth and relevance in the future.

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REVOLUTIONSING QUICK COMMERCE: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING INNOVATIONS

Sowjanya N, Sri Nithya Mohan

ABSTRACT

In an attempt to meet the growing demand for speed and convenience, quick commerce (QC), an organisation widely recognised for its quick delivery services, has drastically altered present behaviour among consumers. Significant advancement has been made in this area as an outcome of the incorporation of machine learning (ML) and artificial intelligence (AI), which has helped companies improve consumer satisfaction and streamline operations.

The optimisation of crucial QC procedures like inventory management, customised shopping, predictive analytics, and delivery logistics is examined in this article. According to the research, AI-powered solutions have increased inventory accuracy, boosted delivery effectiveness by optimising routes, and promoted tailored client interactions, all of which have raised customer satisfaction levels.

Data security concerns and operational inefficiencies still exist in spite of these advances. The article additionally touches on the rising importance of sustainable procedures in QC as well as the broader implications of AI and ML on ethical issues. Concluding remarks highlight their vital role in transforming QC and propose areas for further research to address existing gaps and unlock new opportunities.

KEY WORDS:

Quick Commerce (QC), Artificial Intelligence (AI), Machine Learning (ML), Customer Satisfaction and Sustainability Practices

INTRODUCTION

Due to the shift in pace of modern consumer lifestyles, the quick commerce (QC) sector has emerged, defined by its capacity to deliver goods and services in a matter of minutes. QC has revolutionised the retail and e-commerce sectors, establishing new standards for efficiency and convenience since consumers today clearly place a higher value on speed and quality. Leading this growth are machine learning (ML) and artificial intelligence (AI), which have revolutionised operational capacities and allowed companies to adjust to changing customer demands in previously unheard-of ways.

Recent research shows that AI and ML have been crucial in improving inventory accuracy, route optimisation, and customised shopping experiences in the QC industry, which has prompted businesses to increase customer pleasure and streamline operations. For instance, research by Besharati et al. (2023) demonstrates that AI-powered delivery systems can reduce average delivery times by up to 25%, while predictive analytics models used by companies like Gorillas have enabled accurate demand forecasting, thereby minimising inventory wastage. Similarly, Zepto's adoption of AI-driven route optimisation algorithms have ensured deliveries within a 10-minute window, as noted by Kapoor et al. (2022). With big cities like Mumbai, London, and New York acting as centres of AI-driven commerce innovation, these advances have made QC a global trendsetter.

There are still a lot of challenges to be solved in spite of these achievements. Moral conundrums are becoming prevalent, such as privacy concerns brought on by using consumer data for predictive analytics. Studies by Lee et al. (2022), for instance, raise concerns around permission and data ownership and caution against the

possible abuse of AI systems in profiling consumer behaviour. Additionally, sustainability challenges—such as the increased carbon footprint from rapid delivery logistics and over-reliance on packaging materials—pose a critical threat to the environmental viability of QC. Research by Johnson and Patel (2023) underscores the urgent need for QC companies to adopt green logistics practices and biodegradable materials to address these concerns. There is an apparent absence of investigation on how AI and ML may solve ecological problems, ethical challenges, and long-term changes in consumer habits, despite the fact that previous
works have examined QC's advancements in technology and operational effectiveness. By evaluating the wider implications of AI and ML in QC and their potential for solving pressing problems confronting the sector, this study strives to fill these gaps.

This study's main research question is: "How can AI and ML innovations address Quick Commerce's ethical principles, sustainability challenges, and operational inefficiencies?"

According to this study, AI and ML could minimise operational inefficiencies, resolve ethical difficulties, and enhance sustainable practices, ensuring that QC remains an efficient and user-friendly solution in the long run. By emphasising these crucial elements, the study aims to balance technological innovation with ethical business practices and offer beneficial findings for companies and regulators.

OBJECTIVES

To examine how AI and machine learning could promote efficient commerce techniques, with a spotlight on significant operational domains such as delivery logistics, inventory control, personalised shopping, and predictive analytics.

To find out how AI affects customer happiness by making operations more efficient and giving customers more personalised shopping experiences.

To address ethical and sustainability challenges in quick commerce, addressing concerns about data security, ethical implications, and sustainable practices, and suggesting areas for further research and development.

LITERATURE REVIEW

Naomi Haefner et al. (2021) pronounced how far AI affects innovation management and organisational structures. Rapid technological advancements and the growing role of AI may require companies to rethink their entire innovation processes. Drawing from the Carnegie School and the behavioural theory of the firm, the paper examines the impact of AI and machine learning on innovation management. It introduces a framework outlining how AI can replace human functions and highlights key considerations for transforming the innovation process in digital organizations. The study concludes by suggesting directions for future research in this area.

Alice Harter et al. (2022) had studied and explored how delivery time deviations in quick commerce (Q-commerce) impact repurchase behaviour. Quick commerce focuses on delivering products within minutes to meet consumers' instant needs, making delivery speed critical. The study, using transaction data from a Western European food delivery service and a controlled online experiment, finds that late deliveries increase interpurchase times, while early deliveries decrease them. However, the effects diminish with larger deviations in delivery times. Importantly, late deliveries have a

stronger negative effect on repurchase behaviour than early deliveries of the same magnitude. The research identifies customer satisfaction as the key psychological factor mediating the relationship between delivery time deviations and repurchase behaviour. The findings contribute to the understanding of how delivery time impacts customer behaviour and offer practical insights for optimising delivery algorithms and improving service recovery in Q-commerce.

Anton Zhuk et al. (2024) studied and discussed the integration of artificial intelligence (AI) and machine learning (ML) into e-commerce marketing strategies to address challenges faced by traditional approaches, such as a lack of personalisation and difficulty adapting to changing consumer behaviour. AI and ML enable real-time marketing initiatives and data analysis, enhancing customer relationship management, operational efficiency, and customer-centric advertising. The e-commerce experience has been completely transformed by technologies that provide personalised and interactive buying alternatives, such as visual search, virtual personal shoppers, and real-time product targeting. Large amounts of client data are analysed using AI and ML to find trends and preferences, which enables companies to optimise their product offers and run focused marketing efforts. By combining these technologies, a competitive edge is gained, sales are increased, and customer engagement is enhanced. However, high-quality data, a robust AI infrastructure, and ongoing monitoring and optimisation are necessary for effective deployment.

In their analysis of the connection between corporate strategy and artificial intelligence (AI), Fotis Kitsios et al. (2021) emphasise AI's capacity for digital transformation. In order to create a theoretical model that highlights four important sources of value creation—AI integration, business strategy alignment with AI tools, knowledge management, and service innovation—the study conducts a thorough literature assessment of 81 peer-reviewed articles. The results provide fresh approaches and tactics for using AI to gain a long-term competitive edge in the context of industry and digital transformation.

Raffaele Cioffi et al. (2020) study, digging deep into the ways that machine learning (ML) and artificial intelligence (AI) would support sustainable manufacturing and intelligent production. The reason for the study is to look into how AI and ML are utilised in the manufacturing sector, especially in light of Industry 4.0. The paper throws the spotlight on the growing evolution of these technologies in advancing industrial sustainability through a thorough analysis of the scientific literature on the topic. The smart manufacturing revolution is mostly being driven by AI-based methods, particularly machine learning. The literature review includes 82 articles published between 1999 and the present, using databases like Web of Science and SCOPUS and tools such as UCINET and NVivo 12. Key findings reveal that the USA has published the most research in this area, with increasing interest in AI and ML following the introduction of Industry 4.0. The review also classifies studies based on publication year, authors, institutions, and other relevant keywords, providing valuable insights into trends and directions for future research.

Arpit Sharma (2023) has studied the role of artificial intelligence (AI) in

predicting customer behaviour and personalising the shopping experience in Q-commerce, a crucial sector of the retail industry as online shopping grows in popularity. The study begins with a detailed literature review on customer behaviour, personalisation techniques, and AI types used in Q-commerce. Through this review and analysis of relevant case studies, the paper provides a comprehensive overview of AI's impact. Findings indicate that AI can significantly enhance prediction accuracy and increase conversion rates via personalised recommendations. However, ethical and privacy concerns must be addressed, emphasising the responsible and transparent use of AI in quick commerce.

Ahemed F et al. (2022) study explores the opportunities and challenges of the q-commerce (quick commerce) industry in South Asia. As consumers increasingly rely on q-commerce for its fast delivery and convenience, they still encounter issues. The research aims to understand q-commerce customer needs and identify industry opportunities to address these problems. Using a quantitative methodology, the study gathers data from Q-commerce customers through questionnaires. Regression analysis reveals that pricing, convenience, and security significantly influence consumer decisions. The findings indicate that while customers appreciate the convenience and low prices of q-commerce, they have concerns about security, particularly regarding the amount of personal information requested by stores. Despite these security concerns, customers continue to prefer q-commerce for its time-saving benefits.

By highlighting several trends and opportunities, the Bharadiya J. et al. (2023) paper emphasises the integration of artificial intelligence and machine learning in corporate intelligence. Businesses may implement machine learning algorithms and predictive analytics to reduce risks, expedite processes, and anticipate customer wants. Automated detection, demand forecasting, automated data analysis, and dynamic pricing are made easier by chatbots and virtual assistants driven by AI, which minimise expenses while generating new revenue streams. Businesses benefit from this integration, which also encourages innovation in the digital era.

According to a 2022 study by Vayola Jocelyn, traditional Kirana buying practices in India are changing quickly, especially in cities. Urban middle-class families are increasingly choosing online shopping despite food stores making up 21% of the economy. This trend is the result of intensive marketing campaigns, COVID-19 lockdowns, and e-commerce behemoths like Amazon and Flipkart. In 2022, the Indian online grocery business was expected to be worth 396 billion rupees. Nonetheless, supermarkets make up around 4% of grocery stores, with over 95% still being Kirana stores. With big firms like BigBasket, Blinkit, Swiggy, Instamart, and Zepto, JioMart and Dunzo are providing 10–20-minute delivery, and the rapid commerce (q-commerce) business in India is also expanding.

Iqbal Z et al. (2024) standard three-tier approach for patentability (novelty, inventive step, industrial applicability) under the WTO's TRIPs agreement is widely adopted. However, TRIPs allow the exclusion of certain inventions (e.g., scientific theories, mathematical methods, abstract ideas) from patent eligibility, and member states implement these exclusions differently. The rise of new technologies in biology and computer science, especially big data, AI, and ML, has necessitated re-

evaluating patent-eligible subject matter. AI/ML innovations, particularly in digital healthcare and biomedical applications, are challenging traditional patent approaches. This article reviews the eligibility standards of the USPTO and EPO, judicial decisions, and policies, providing a framework for AI/ML patent claims. It concludes that patent laws should balance the risks of under- and over-protection, allowing technology owners to protect their innovations without hindering the free flow of technical information.

RESEARCH METHODOLOGY

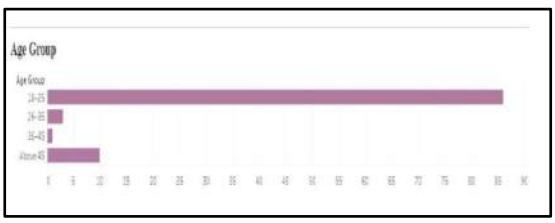
Sample Size	100 Responses Completed for Analysis
Sampling Technique	Purposive Sampling
Study Area and Period	India and 2nd week of December
Data Collection	Primary: Questionnaire
	Secondary: several sources
Target Population	Indians
Software Used	Tableau

DATA ANALYSIS

Demographic Information

Age Group

Chart 1.1

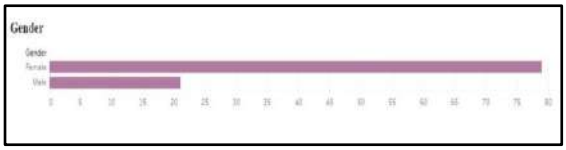


Interpretation:

The data reveals a noteworthy age distribution, with 86% of the population falling into the 18–25 age range. This implies that younger people make up the main audience, which probably reflects the tastes of a generation that is tech-savvy and actively involved in digital media. The prevalence of this age group aligns with the lifestyle, convenience, and trends favoured by Gen Z and younger millennials. The 26-35 age group represents only 3%, suggesting a decline in relevance for older millennials due to differing priorities. The 36-45 age group accounts for only 1%, showing minimal engagement or interest. The age group above 45 years comprises 10%, which is unexpected compared to middle-aged groups, possibly reflecting niche adoption by older generations for specific features or convenience.

Gender

Chart 1.2

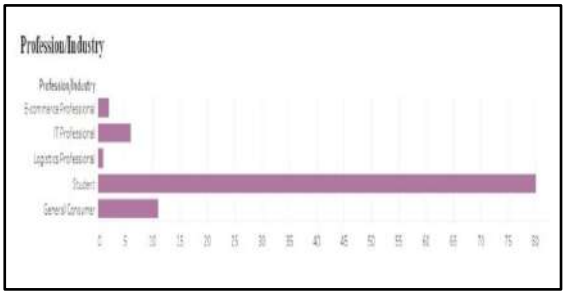


Interpretation:

79% of the population is female, while only 21% is male, according to the data, indicating a large gender distribution. This implies that the good or service meets certain requirements, such as those related to convenience, style, or lifestyle compatibility. Male consumers may find the discrepancy in male representation to be a sign of decreased interest or perceived relevance. This gender gap highlights how crucial it is to change product features and marketing strategies to appeal to women and consider methods to increase male involvement.

Profession/Industry

Chart 1.3

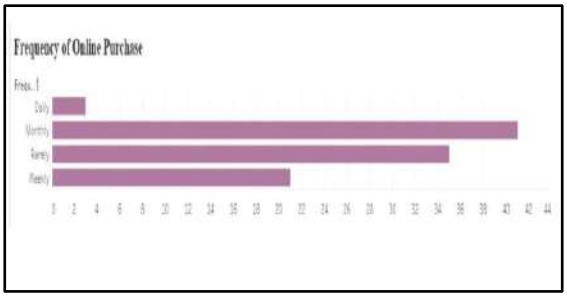


Interpretation:

80% of the population is students, according to the data, with a focus on young, tech-savvy, convenience-driven individuals between the ages of 18 and 25. They rely heavily on e-commerce platforms for quick solutions like food delivery and study materials. General consumers make up 11% of the audience, indicating a broader appeal beyond specific professional niches. E-commerce professionals and IT professionals make up 2% and 6%, respectively, with a small interest in AI and ML technologies for professional insights. Logistics professionals make up 1%, with a focus on operational efficiencies. Entrepreneurs are surprisingly low at 0%, suggesting a lack of awareness or perceived relevance. The data underscores the need for solutions tailored to a younger, digitally inclined audience and exploring ways to increase engagement among entrepreneurs and logistics professionals.

Frequency of Online Purchases

Chart 1.4

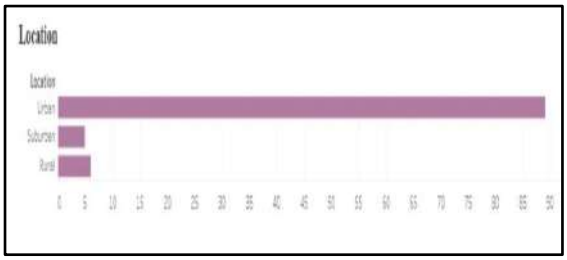


Interpretation:

The data shows a significant distribution in online purchases among consumers. 41% make monthly purchases, indicating a periodic approach to online shopping. This could be due to budgeting, planning, or preference for non-urgent or high-value items. 21% engage with online shopping platforms regularly, driven by convenience and speed. Daily shoppers, at 3%, are niche but highly engaged, likely buying quick-delivery products or digitally native individuals. 35% shop rarely, indicating a lack of trust in online shopping. Addressing trust, accessibility, and ease of use could convert "rare" shoppers into more frequent buyers. The small daily shopper segment emphasises the importance of catering to highly frequent buyers with services like quick commerce and loyalty programs.

Location

Chart 1.5



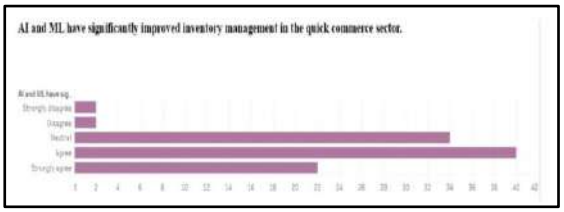
Interpretation:

The data shows a significant geographical distribution, with urban areas accounting for 89% of the total demographic, indicating a preference for densely populated, high-demand metropolitan regions. This is due to the infrastructure and technological accessibility required for services like quick commerce, which thrive on proximity and speed. Suburban areas represent only 5%, suggesting limited adoption due to lower population density and slower lifestyles. Rural areas make up 6%, presenting challenges like logistical

inefficiencies and limited infrastructure. Companies should prioritise urban markets for expansion and innovation.

AI and ML have significantly improved inventory management in the quick commerce sector.

Chart 1.6

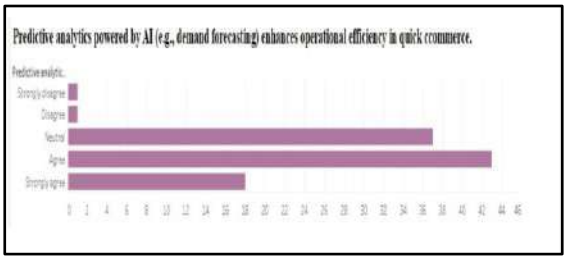


Interpretation:

The data on AI and ML's impact on inventory management in the Quick Commerce sector shows mixed opinions. 62% of respondents agree or strongly agree and agree that AI and ML have positively influenced inventory management, suggesting they enhance efficiency and accuracy. However, 34% remain neutral, suggesting a lack of awareness or a lack of uniformity in their effectiveness across the sector. A small percentage, 4%, feel AI and ML have not had a significant impact, possibly due to challenges like integration issues, cost, or concerns about reliability and scalability. The research indicates that usage of AI and ML is on the rise, but that more knowledge, instruction, or advancements are required to increase their perceived efficacy.

Predictive analytics powered by AI (e.g., demand forecasting) enhances operational efficiency in quick commerce.

Chart 1.7

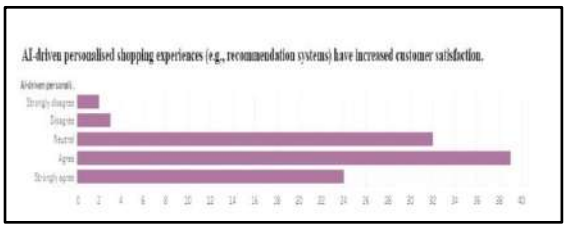


Interpretation:

Most respondents (43%) concur that demand forecasting and other predictive analytics driven by AI increase operational efficiency in fast commerce. This suggests a keen understanding of the part AI plays in streamlining supply chains, cutting down on waste, and meeting customer needs. The fact that 37% are neutral, however, points to a lack of knowledge or exposure to the precise effects of predictive analytics in QC. A small percentage (1%) strongly disagree and 1% disagree, indicating reservations or alternative views regarding the effectiveness of predictive analytics in improving operational efficiency. These dissenting opinions may stem from concerns about forecast accuracy or the challenges of implementing AI systems in fast-moving operational contexts. Overall, the data suggests a broad consensus in favour of predictive analytics as a valuable tool for enhancing efficiency in quick commerce, with a substantial portion of respondents agreeing with its positive impact.

AI-driven personalised shopping experiences (e.g., recommendation systems) have increased customer satisfaction.

Chart 1.8



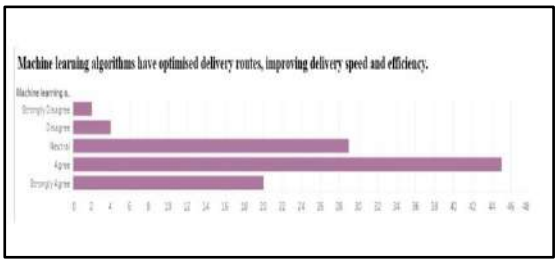
Interpretation:

The majority of respondents (63%) agree or strongly agree that AI-driven personalised shopping experiences have increased customer satisfaction. However, 32% remain neutral, suggesting that AI recommendations need improvement in

precision, relevance, and user appeal. This neutrality may indicate a lack of awareness or understanding of how AI enhances shopping experiences. Only a small fraction (5%) disagrees or strongly disagree, indicating minimal dissatisfaction with AI-driven recommendations. This low level of disagreement suggests that AI systems are successfully meeting consumer expectations, but their impact is not universally transformative. The data highlights the growing importance of AI in shaping customer satisfaction but also suggests a need for further refinement of recommendation systems to convert neutral respondents into satisfied ones. This may involve addressing concerns like data privacy, enhancing personalisation algorithms, or making these systems more transparent and user-friendly.

Machine learning algorithms have optimised delivery routes, improving delivery speed and efficiency.

Chart 1.9



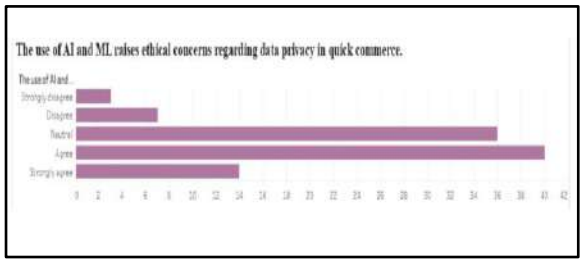
Interpretation:

The vast majority of respondents (65%) think that delivery routes have been made better by machine learning algorithms, demonstrating a thorough comprehension of their function in logistics operations. But 29% are neutral, perhaps because they haven't been exposed to or experienced these developments themselves. Only 6% express scepticism, indicating minimal opposition or disbelief in the benefits of machine learning in this context. This low percentage might reflect a positive perception of technology's role in delivery systems. The majority view machine learning as a valuable tool in improving delivery operations, but a significant proportion remain indifferent or undecided, highlighting the need for better awareness campaigns and tangible demonstrations of the technology's efficiency in real-world scenarios.

Ethical and Sustainability Considerations

The use of AI and ML raises ethical concerns regarding data privacy in quick commerce.

Chart 1.10



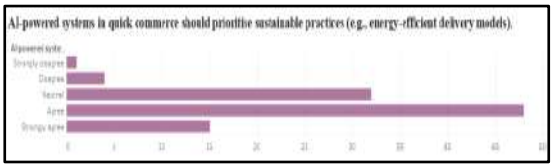
Interpretation:

According to a survey, ethical issues concerning

data privacy in rapid commerce are widely acknowledged, with 40% of respondents expressing these concerns and 36% remaining indifferent. This shows that a sizable proportion of the population is unsure or apathetic to the ethical implications of data privacy. However, only a small minority of 3% and 7% actively rejects the notion that AI and ML raise privacy concerns in quick commerce. The high percentage of neutral responses could be due to a lack of awareness or understanding of the ethical challenges posed by AI and ML in quick commerce, or respondents are not deeply affected by these concerns. The survey suggests that companies and policymakers have a significant opportunity to educate consumers and implement transparent data-handling practices.

AI-powered systems in quick commerce should prioritise sustainable practices (e.g., energy-efficient delivery models).

Chart 1.11

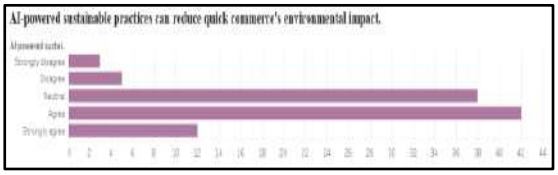


Interpretation:

The majority of respondents (63%) support eco-friendly activities and strongly agree that AI-powered technologies in rapid commerce should prioritise sustainability. This indicates a rise in consumer knowledge of environmental issues and their demand for companies to implement ethical practices. The majority (32%) do not, however, have strong ideas or enough knowledge regarding how AI might promote sustainability in fast commerce. Businesses may have a chance to inform customers about the negative effects of rapid commerce on the environment and how artificial intelligence (AI) might help address these issues. A tiny minority (5%) disagreed (4%) or strongly disagreed (1%) with the idea of making sustainability a top priority, pointing out the possible compromises that companies may have to make in order to strike a balance between cost, speed, and environmental friendliness. The research emphasises the significance of raising awareness and communicating openly in order to connect rapid commerce tactics with consumer expectations for sustainability.

AI-powered sustainable practices can reduce quick commerce's environmental impact.

Chart 1.12



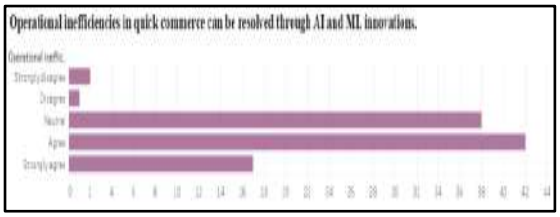
Interpretation:

The vast majority of respondents (54%) think AI can play a big role in solving sustainability issues in sectors like fast commerce. 38%, however, have no opinion, indicating a lack of knowledge on AI's contribution to sustainability. This implies that further education and awareness-raising efforts are required to clarify the connection between advancements in AI and environmental advantages. A smaller proportion, 8%, express scepticism about AI's capability to contribute to sustainability, possibly due to concerns about the implementation of AI-driven practices. The data emphasises the need to demonstrate tangible examples of AI's positive environmental impact to shift these perceptions, particularly targeting the neutral demographic, which is the largest single group, to foster widespread acceptance and adoption of sustainable AI practices in quick commerce.

Challenges and Future Potential

Operational inefficiencies in quick commerce can be resolved through AI and ML innovations.

Chart 1.13



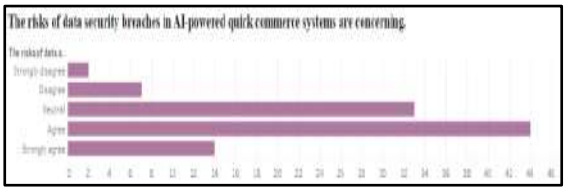
Interpretation:

According to the survey's findings, opinions on how AI and ML advancements might help Quick Commerce (QC) overcome operational inefficiencies are divided. 38% of respondents took a neutral position, indicating doubt brought on by a lack of exposure to or knowledge of their advantages, despite 42% agreeing and 17% strongly agreeing. The low percentage of

disagreement suggests minimal scepticism, suggesting a general acknowledgement of the theoretical promise of these technologies. The high level of neutrality may also reflect the novelty of QC or the complexity of operational issues aimed at by AI and ML. Participants may need more evidence or examples of successful implementations to form a stronger opinion. Concerns over cost, scalability, or ethical implications may also influence their opinion. In conclusion, while there is a positive perception of AI and ML as enablers for QC inefficiencies, a significant neutral response suggests more awareness, education, and practical demonstrations are needed to build stronger confidence in their transformative potential.

The risks of data security breaches in AI-powered quick commerce systems are concerning.

Chart 1.14

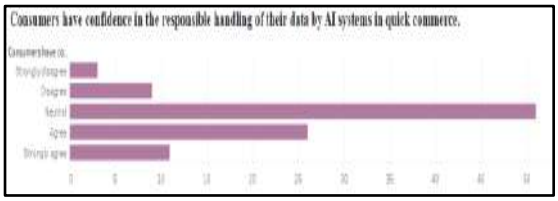


Interpretation:

A survey reveals a wide range of consumer confidence in AI systems handling their data in Quick Commerce (QC). 37% of respondents expressed confidence, while 51% maintained a neutral stance, suggesting uncertainty about the implications of AI-driven data handling. Only 12% expressed distrust, suggesting low scepticism about data misuse or ethical concerns. The neutrality may reflect consumer unfamiliarity with AI systems' data management or a lack of transparent practices by QC companies. This hesitancy may stem from concerns about data privacy in the digital age and limited understanding of AI-driven processes in QC. Positive responses show growing trust in AI's potential to handle data responsibly, possibly fuelled by successful implementations or assurances by QC brands. The high level of neutrality suggests an opportunity for QC companies to enhance transparency and communication about their data-handling practices. Building awareness and showcasing ethical AI practices could convert neutral opinions into stronger consumer confidence.

Consumers have confidence in the responsible handling of their data by AI systems in quick commerce.

Chart 1.15



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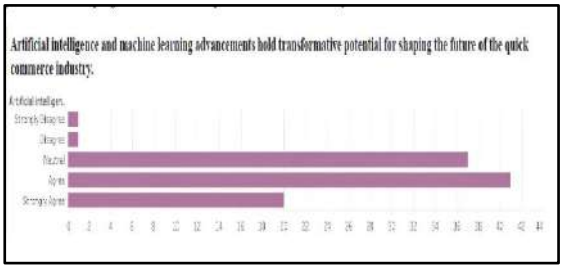
to enhance transparency and communication about their data-handling practices. Building awareness and showcasing ethical AI practices could convert neutral opinions into stronger consumer confidence.

Artificial intelligence and machine learning advancements hold transformative potential for shaping the future of the quick commerce industry.

Chart 1.16

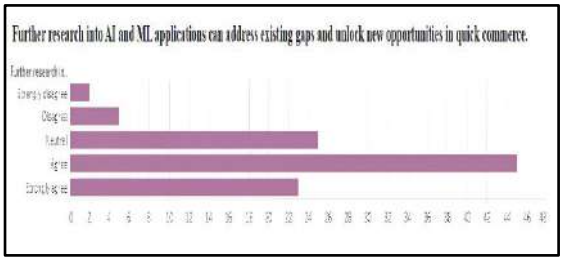


Interpretation:

The study results indicate that there are differing views on the potential of AI and machine learning in the Quick Commerce (QC) industry. 41% of respondents agreed and 20% strongly agreed that breakthroughs in AI and ML have the potential to be revolutionary, representing the majority of respondents (61%) who agreed. This shows that their importance in resolving operational inefficiencies and satisfying customer demands for speed and personalisation is becoming increasingly acknowledged. However, a high proportion of respondents (37%) expressed uncertainty or hesitation, possibly due to limited familiarity with QC-specific applications or an awareness gap regarding their practical benefits and successful implementations. The remaining respondents (1% strongly disagreed and 1% disagreed), suggesting a low level of opposition, indicating broad theoretical acceptance of these technologies. The survey results suggest a need for more education, practical demonstrations, and evidence-based outcomes to build confidence in AI and ML's potential. Future efforts should focus on showcasing successful use cases and addressing concerns related to implementation costs, scalability, and ethical implications.

Further research into AI and ML applications can address existing gaps and unlock new opportunities in quick commerce.

Chart 1.17



Interpretation:

The survey results indicate a generally positive outlook on the potential of AI and ML applications to address operational inefficiencies in Quick Commerce (QC). A total of 68% of respondents agreed or strongly agreed that AI and ML innovations could drive improvements in QC, indicating their transformative potential. However, 25% remained neutral, suggesting they may feel unsure due to limited exposure, understanding, or practical demonstrations of AI and ML in this context. The low percentages of disagreement suggest minimal scepticism about the viability of these technologies in QC, suggesting a growing trust in their potential to revolutionise industries. However, the significant proportion of neutral responses suggests that many participants are still in the process of forming a definitive opinion, possibly due to a lack of concrete examples or concerns about cost, scalability, or ethical challenges associated with these innovations. In conclusion, the survey results suggest a

generally favourable perception of AI and ML as enablers for overcoming operational inefficiencies in QC.

RESULTS

The survey results deliver an in-depth assessment of major results regarding AI and ML in Quick Commerce (QC), comprising demographic information, AI/ML applications, and ethical considerations. Both positive and negative data can be obtained with additional insights on their associations, differences, and significance.

Demographic Analysis:

Age: The overwhelming majority of those who responded (86%) were in the 18–25 age range, demonstrating that younger, tech-savvy consumers are keen for AI and ML-powered products. Significantly decreased degrees of involvement were identified by respondents over the ages of 26 and 35 (3%) and 36 and 45 (1%), suggesting that the older age groups are becoming less relevant.

Gender: Female responses dominated (79%), implying that AI-powered quality assurance services are more appealing to female users. This suggests a need for specialised initiatives to engage male consumers.

Profession/Industry: 80% of respondents were students, reflecting a digitally native and young demographic driving demand for quick commerce. In contrast, professionals from fields like e-commerce (2%), IT (6%), and logistics (1%) represented a much smaller portion, indicating that the professional sector is still somewhat disengaged with AI and ML in QC.

Online Shopping Behaviour:

Frequency of Purchases: The frequency of online shopping varied, with 41% of respondents making purchases on a monthly basis and 35% shopping rarely. Only 3% were daily shoppers, suggesting a steady but occasional market for quick commerce.

Location: Urban areas dominated the responses (89%), indicating that quick commerce is primarily driven by high-density areas, while suburban (5%) and rural (6%) respondents were less engaged, pointing to challenges related to infrastructure and accessibility in those regions.

AI and ML Impact:

Inventory Management: AI and ML have a favourable impact on inventory management, increasing accuracy and operational efficiency, according to 62% of respondents who agreed or strongly agreed. This result, which illustrates the broad recognition of the technology's ability to streamline processes, is noteworthy. However, 34% remained neutral, which can be considered non-significant, suggesting some uncertainty or lack of exposure to these technologies in QC. Just 4% disagreed.

Demand Forecasting with Predictive Analytics: 43% of respondents claimed that AI enhanced demand forecasting, which in turn increased operational efficiency; 37% were unsure. This offers an interesting but ambiguous viewpoint: while AI has the potential to improve operational efficiency, further research is needed to properly comprehend its use. There was little opposition, since only 2% disagreed.

AI-driven personalised shopping experiences increased customer happiness, according to 63% of respondents. Nevertheless, 5% disagreed and 32% stayed indifferent, which is again not statistically significant. While most consumers recognise the value of personalisation, the neutral responses

highlight an opportunity for refining the personalisation process to meet varying customer expectations.

Machine Learning in Delivery Optimisation:

Route Optimisation: 65% of respondents noted that ML algorithms improved delivery route optimisation, enhancing both speed and efficiency. However, 29% were neutral, which can be regarded as non-significant, suggesting a lack of direct experience or understanding of these advancements. A small 6% disagreed, showing overall positivity towards ML in logistics. The neutral responses represent a gap in awareness, indicating the need for more consumer education in ML-driven logistics.

Concerns regarding Ethics and Sustainability:

Data Privacy: Of those surveyed, 40% voiced worries about the ethical ramifications of data privacy in AI-powered quality control, while 36% were undecided. These indifferent answers can be seen as non-significant, suggesting that while there is some understanding of possible hazards, there isn't a clear agreement on how to handle these problems. While data privacy is a concern for many consumers, it may not be an instant deterrent for all of them since only 10% disapproved or strongly rejected. Although not all respondents may currently find these ethical issues to be of utmost importance, addressing them is essential to preserving confidence in AI-driven QC services.

Sustainability: According to 63% of respondents, AI-powered systems ought to give sustainability first priority, especially when it comes to energy-efficient delivery methods. More consumer education is necessary regarding the relationship between AI, ML, and sustainability in QC, as evidenced by the 32% who were ambivalent, which can be regarded as non-significant. A small proportion (6%) disagreed, signalling that sustainability may not be a top priority for all consumers but remains a factor that requires ongoing attention from QC companies.

Future Potential:

Transformative ability: Of those surveyed, 61% agreed, with 20% strongly agreeing, that AI and ML technologies had the ability to revolutionise fast commerce in the future. 37%, on the other hand, had no opinion, suggesting that they are generally accepted but that their actual use is unknown. While acknowledging the potential of AI, this also emphasises the need for more convincing examples of its practical uses.

Research and Development: While 25% of respondents were neutral, 68% of respondents thought that additional advancements in AI and ML could open up new QC prospects. This shows significant optimism for future technological advancements but suggests a gap in understanding how these innovations will impact the industry.

Key Findings:

Positive: The majority of respondents recognised the positive impact of AI and ML on inventory management, personalised shopping experiences, operational efficiency, and delivery optimization. These findings underscore the strong potential of AI-driven solutions, particularly for younger, tech-savvy audiences in urban areas. The 62% agreement on the impact of AI in inventory management and the 65% support for ML in delivery optimisation highlight significant technological advances in quick commerce.

Negative: Despite the overall positive reception, a notable portion of respondents remained neutral, especially regarding predictive analytics (37%) and data privacy concerns (36%). This reflects varying levels of awareness and understanding of AI and ML's full benefits, suggesting that while the technology holds promise, many consumers remain unsure about its practical value and ethical implications. These neutral responses can be classified as non-significant, indicating gaps in consumer education and experience. Greater transparency and targeted education are needed to overcome all of these challenges.

Notable Results: The most noteworthy results include agreement about AI's contribution to increasing operational effectiveness, specifically in the areas of delivery optimisation (65%) and inventory management (62%). Other important considerations were sustainability and ethical issues, especially those pertaining to data privacy. These concerns must be addressed by QC companies to align their practices with consumer expectations. The neutral responses in areas like predictive analytics and sustainability underscore the importance of ongoing consumer education to fully realise the potential of AI and ML in quick commerce.

DISCUSSION

The study results provide vital insights into the growing significance of AI and machine learning (ML) in quick commerce (QC), with a focus on operational effectiveness, personalised shopping experiences, and customer concerns about sustainability and ethics. The majority of respondents, particularly those aged 18 to 25, indicate high support for incorporating AI and ML into QC.

A noteworthy conclusion from this poll is the awareness of AI's impact on inventory management, with 62% of respondents reporting increased operational efficiencies. This is congruent with research by Helo et al. (2019), who found that AI can improve inventory accuracy and lower supply chain management costs. The positive reception aligns with other research emphasising AI's ability to optimise stock levels and streamline logistics (Choi et al., 2021). However, the 34% neutral responses suggest that while AI-driven solutions have been acknowledged, there remains a gap in understanding or exposure to the full potential of these technologies (Sharma & Garg, 2020).

Similarly, 65% of respondents affirmed the positive impact of machine learning (ML) on route optimisation for delivery systems. This resonates with Gubbi et al. (2013), who demonstrated that ML algorithms can enhance delivery efficiency by factoring in variables such as traffic and customer demand in real time. The 29% neutral responses indicate that some consumers may not fully grasp how these innovations directly influence their shopping experiences. As such, increased transparency and communication from QC companies regarding the benefits of ML could foster broader acceptance and understanding (Srinivasan & Swaminathan, 2020).

Furthermore, 63% of respondents were more satisfied with AI-driven tailored purchasing experiences, which is consistent with Kumar and Shah's (2020) finding that customisation has a major impact on e-commerce customer behaviour. AI's capacity to provide tailored experiences not only increases customer pleasure but also

develops brand loyalty (Sharma & Garg, 2020). However, the 32% of neutral responses indicate that AI tools require more refining to better satisfy the diverse needs of their users. This disparity could be due to a lack of understanding about how AI works or insufficient personalisation possibilities, highlighting the need for ongoing progress in personalisation technologies.

Ethical concerns, particularly over data privacy, were also prevalent, with 40% of respondents expressing reservations. This is consistent with worldwide trends in which consumers want increased responsibility and openness from organisations that use AI to acquire data (Zhou et al., 2021). Likewise, a notable 63% of respondents felt the need for power-packed, efficient delivery mediums, suggesting a desire for AI-powered solutions but with sustainability. As we scan through the results, it is likely visible that the e-commerce sector is dependent more and more on sustainability and sustainable practices. While a tiny percentage of respondents expressed apathy or disagreement with these issues, addressing them is critical to retaining consumer trust and encouraging long-term use
of AI technology in QC.

Looking ahead, 61% of respondents felt that AI and ML technologies might transform QC, which is consistent with research indicating that AI can create new opportunities, particularly in predictive analytics, operational efficiency, and customer experience (Pantano et al., 2020). However, the 37% neutral responses reflect a degree of uncertainty about how these technologies will be practically implemented. This ambivalence could stem from the limited availability of concrete case studies or demonstrations. As a result, further investigation and hands-on examples are needed to increase consumer confidence in the transformative potential of AI and ML.

In conclusion, this study underscores the significant potential of AI and ML to enhance customer satisfaction, operational effectiveness, and delivery optimisation in quick commerce. However, challenges remain, including gaps in consumer knowledge, education, and concerns about ethics. Future research should focus on bridging these gaps by providing more practical examples of AI and machine learning applications, as well as addressing ethical issues more completely. Furthermore, the study's limitations, particularly the over-representation of younger, tech-savvy customers, highlight the need for a more varied sample with a wider age range and professional backgrounds. This will offer a more nuanced understanding of how different consumer groups perceive AI and ML in quick commerce and guide more targeted strategies for their implementation.

CONCLUSION

The implementation of AI and ML in Quick Commerce has evolved the industry and enhanced the efficiency, client satisfaction, and optimisation of delivery. The study has also examined vital areas such as inventory management, personalised shopping experiences, demand forecasting, and route optimisation, revealing the substantial impact these technologies have on shaping the future of commerce. AI and ML have proven to enhance various aspects of QC operations. A significant 62% of respondents reported improved inventory management, and 65% acknowledged the effectiveness of ML in optimising delivery routes. More into it, 63% of customers applauded the personalised shopping

experiences that have been enabled by AI. These findings are consistent with existing research that demonstrates the role of AI in enhancing efficiency and customer experience.

Though there are some data points that remain ambiguous, especially regarding predictive analytics and route optimisation. 37% of notable respondents remained neutral on predictive analytics, and 29% expressed their neutrality on route optimisation, consulting there may be a gap in consumer awareness or understanding of these technologies. This highlights a need for more targeted education and consumer engagement to fully unlock the potential of AI in QC.

The outcomes underscore the evolving significance of AI and ML in enhancing both operational processes and customer experiences. The study also revealed critical ethical concerns, with 40% of notable respondents expressing concerns about data security—indicating a need for more transparent data practices. Furthermore, sustainability emerged as a key issue, with 63% of respondents emphasising the significance of energy-efficient delivery methods. This shows a clear consumer demand for AI solutions that address environmental concerns while maintaining operational efficiency. The younger, tech-savvy demographic, which denoted 86% of respondents aged 18–25, demonstrated a keen interest in AI and ML-driven QC, with a spot light on the future potential of these technologies in catering to a digitally native consumer base. However, the survey found a lack of engagement among older demographics and professionals, highlighting the need for focused measures to expand the accessibility of AI-powered services.

The findings substantially support the hypothesis that AI and machine learning may revolutionise quality control by increasing operational efficiency and customer happiness. While the neutral responses to certain technologies suggest that further consumer education is needed. The positive reception of AI's capabilities in inventory management, personalised experiences, and delivery optimisation strengthens the hypothesis that AI can address critical challenges in QC.

The study suggests several areas for further investigation. First, resolving concerns about data privacy and security should be a major goal in order to gain consumer trust. Furthermore, additional case studies and hands-on demonstrations of AI and ML technologies in QC are needed to close the knowledge gap and stimulate wider usage. Finally, research into more sustainable and energy-efficient AI technologies is clearly needed to fulfil the growing demand for ecologically responsible delivery practices. AI and machine learning advancement has the potential to entirely revolve the control by decreasing operational inefficiencies, raising customer satisfaction, and advancing sustainability. However, the advancements can be achieved in the long term only if data security, customer education, and ethical considerations are resolved. The quality control industry can fully utilise AI and ML by investing in research and development and raising consumer awareness, which will result in a customer-focused, sustainable commerce future. The quality control industry can fully utilise AI and ML by investing in research and development and raising consumer awareness, which will result in a customer-focused, sustainable commerce future.

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BLOCKCHAIN APPLICATIONS FOR SPEED AND SECURITY IN E-COMMERCE

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ABSTRACT

Blockchain technology is transforming digital commerce by tackling key challenges like transaction speed, security, and transparency. As a distributed digital ledger, blockchain guarantees clear and unchangeable records, significantly diminishing opportunities for fraud and hacking. By removing intermediaries and decentralizing data storage, it facilitates quicker and more affordable international transactions, which is especially advantageous for global enterprises. The incorporation of cryptocurrencies and smart contracts simplifies order processing and payment methods, reducing delays, manual errors, and related expenses. Additionally, blockchain improves transparency in supply chains, allowing consumers to authenticate the origins and legitimacy of products, thus building trust between buyers and sellers. Practical examples, such as loyalty programs on the blockchain and decentralized marketplaces, demonstrate its potential to revolutionize e-commerce through enhanced customer engagement and measures against counterfeiting. Furthermore, smart contracts streamline tasks such as inventory control and payment processing, which lessens the workload and minimizes the chances of human mistakes. However, the widespread implementation of these technologies encounters considerable challenges, such as scalability concerns that arise as transaction numbers grow, making innovations like off-chain processing and sharding necessary. Regulatory uncertainties in various countries complicate compliance for companies operating internationally, while the intricate nature of blockchain technology requires significant investment in both infrastructure and expertise. In spite of these obstacles, blockchain holds tremendous potential to create a more secure, transparent, and efficient e-commerce landscape. Its ability to tackle ongoing problems with inventive solutions could dramatically transform the future of online commerce, enhancing reliability and accessibility for all participants. Through careful execution and ongoing innovation, blockchain is set to change the dynamics of global digital commerce.

KEYWORDS:

Hacking Risks, Fraud Prevention, Blockchain Technology, Digital Commerce, Payment Processing, Supply Chain Transparency.

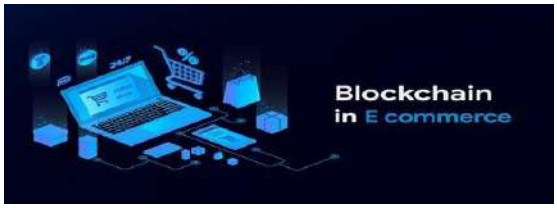
INTRODUCTION

Backgrounds and Context:

The rapid growth of the e-commerce sector in recent years has fundamentally altered how businesses and consumers do business. Thanks to advances in digital technologies, e-commerce has created unprecedented levels of convenience, accessibility, and market reach. However, this transformation has presented challenges, particularly with regard to transaction speed and security. Cybersecurity issues such as identity theft, payment fraud, and data breaches have undermined consumer trust, while transaction processing inefficiencies have resulted in delays and bottlenecks that have hampered efficient operations. To ensure the e-commerce sector's continuous growth and development, these problems must be fixed. With Bitcoin, Satoshi Nakamoto first introduced the decentralised, transparent, and immutable record system known as blockchain to the world in 2008. It makes peer-to-peer communication safe.

Importance of Blockchain in E-commerce:

Blockchain's significance in e-commerce:



Source: Google

Initially introduced by Satoshi Nakamoto in 2008 with Bitcoin, Blockchain is a decentralised, transparent, and immutable record system. Without the use of middlemen, it enables safe peer-to-peer transactions. Because the blockchain is distributed and employs cryptographic techniques, data saved on it is tamper-proof, traceable, and incredibly secure. In the context of e-commerce, blockchain can significantly speed up transactions, enhance transaction security, and safeguard digital identities. Security is another important concern in the context of e-commerce. Due to the increase in cybercrime incidents, which include phishing attempts, fraudulent transactions, and data manipulation, businesses urgently need a solution that guarantees data integrity, transparency, and security. The encryption methods and distributed ledger technology employed. Blockchain ensures that data kept on the network cannot be altered or deleted, enabling safe peer-to-peer transactions while lowering the risk of fraud and hacking. Furthermore, secure user authentication is made possible via blockchain- powered digital identity verification, personal information.

Problem Statement:

The e-commerce sector continues to encounter issues with speed, security, and trust despite its rapid expansion. Among these difficulties are:

Transaction Delays: The several middlemen in conventional payment processing systems cause delays in order confirmation and settlements.

Cybersecurity Risks: Fraud, unauthorised access, and data breaches pose a major threat to consumer and financial data. Lack of Transparency: Customers sometimes lack knowledge about the supply chain, making it difficult to verify the authenticity and country of origin of goods.

Cost Inefficiencies: The higher operating costs of intermediaries affect both businesses and consumers. Blockchain technology, which provides a transparent, decentralised, and secure system that ensures speedy and dependable transactions, may be able to address these problems. This study investigates how blockchain could increase the speed and security of e-commerce operations, offering businesses and decision-makers valuable information.

Research Objective:

This study's main goal is to investigate how blockchain technology can be used to increase e- commerce's speed and security. The study specifically seeks to:

Examine the ways in which blockchain technology can accelerate online transactions: Examine how blockchain eliminates middlemen to enable faster payment processing. Examine the ways in which smart contracts can streamline and automate e-commerce procedures. Look at examples that demonstrate how blockchain can reduce transaction latency.

Analyse Blockchain's Impact on E-Commerce Security: Look at how distributed ledgers and cryptographic techniques can be applied to prevent fraud and preserve data integrity. Examine blockchain-based digital identity verification technologies to ensure secure user identification. Find out how blockchain lowers cybersecurity threats like identity theft, financial fraud, and unauthorised access.

Examine the Practical Applications and Challenges of Blockchain Integration in E-Commerce: Provide examples of real companies utilising blockchain technology for loyalty programs, secure payments, and supply chain management. Identify the financial, legal, and technological barriers preventing blockchain technology from being widely used.

Provide a Framework for Blockchain Use in E-Commerce: Identify the key steps and technological developments for integrating blockchain technology into e-commerce platforms and develop a conceptual framework outlining them. Provide ideas on how businesses could use blockchain to increase security, speed, and efficiency.

Research Scope:

Examining blockchain applications in significant fields such as smart contracts, digital identity verification, supply chain transparency, and payment processing is part of this study's scope. Analysing real-world case studies to understand the benefits and applications of blockchain in e- commerce, including those from Walmart, Loyyal, and OpenBazaar. identifying the barriers to blockchain adoption, such as the high cost of implementation, legal limitations, and technical difficulty. Although the study focusses on global e-commerce trends, it gives special attention to industries and businesses that have successfully implemented blockchain technology.

Source: Google

Concluding remarks:

Blockchain technology is revolutionising the way significant e-commerce issues are resolved, particularly in terms of enhancing transaction speed and security. By leveraging blockchain's decentralised and cryptographic features, businesses can function more swiftly, transparently, and safely. This study aims to provide a comprehensive understanding of blockchain's potential in the e- commerce industry, offering useful data to businesses, lawmakers, and consumers.

REVIEW OF LITERATURE

Taherdoost, Madanchian.,17th April 2023, Blockchain technology has the power to revolutionise online shopping. It can be used to build a decentralised network that makes it possible to safely share and store digital assets, reducing the possibility of fraud and providing buyers with access to product information. This research examines studies on blockchain-based e-commerce, focussing on problems and applications, by reviewing the body of existing literature from 2017 to 2022.Blockchain is a decentralised trust less network that allows users to connect without the need for malevolent activity or reliable middlemen. It has a public ledger and a peer-to-peer automatic access-control manager. Blockchain's extensive use of encryption lends network nodes a feeling of power. Given the rapid growth of the e-commerce sector, the requirement for a safe

Guntara et al., 1st March 2023, With the goal of boosting consumer security and trust in online transactions, the application of blockchain technology in e-commerce has gained substantial attention in recent years. Blockchain can improve security, product tracking, smart contracts, and digital identities, among other facets of e-commerce. Nonetheless, obstacles must be

addressed, including the high expense and duration of system development and integration, as well as legal and regulatory concerns pertaining to cryptocurrencies and digital identities. Blockchain can be utilised for transaction logistical security, user information security, transaction tracking, and identity verification. Only legitimate users are able to conduct transactions thanks to the creation of safe, encrypted digital IDs. All users may see and follow transactions done on the blockchain, which improves transaction transparency and guards against fraud.

Treiblmaier et al., 28th April 2023, with major ramifications for e-commerce, blockchain-based technologies are expected to upend a wide range of commercial applications and procedures. In order to guarantee confidence, dependability, and enforceability in business-to-business, business-to-government, and consumer-to-consumer interactions, blockchain technology and associated technologies have the potential to modify traditional procedures and produce "trustless systems" with special characteristics. Because blockchain technology allows for trustless exchange relationships without the need for specialised middlemen or centralised authorities, it has the potential to upend the foundation of e-commerce. Unified access to immutable data across the whole supply chain could revolutionise the value and information exchange between businesses and customers. In order to encourage researchers to look into the possible effects of blockchain technology on e-commerce, this paper offers a framework and 19 high-level research questions. Technological, legal, organisational, quality, and consumer challenges are the primary categories.

Ayodagan et al., 2022, The COVID-19 pandemic, customer tastes, and technology improvements have all contributed to the huge growth of the e-commerce industry. But it has also brought with it new problems, such pricing, privacy, security, and transparency. A promising answer to these issues is blockchain technology, which offers advantages like privacy, immutability, security, transparency, and auditability together with a decentralised structure that eliminates the need for third-party middlemen. By enabling integrated e-commerce systems that involve all parties and provide low transaction costs, high transaction speed, transaction traceability, robust security standards, and low risks, this study explores the advantages that blockchain can bring to e-commerce and comes to the conclusion that it can transform e-commerce activities. Blockchain-based e-commerce systems have the potential to displace more established platforms, making online buying safer and more effective.

Aifang et al., 2024, In the current digital environment, where cyber dangers are on the rise, e- commerce transaction safety and security are essential. The decentralised, transparent, and unchangeable ledger system of blockchain technology provides a workable answer to these issues. This study explores how to increase the safety and security of e-commerce transactions by combining the cutting-edge Blockchain Consent Algorithm (BCA) with Distributed Ledger Technology (DLT), more especially Decentralised Identifiable Distributed Ledger Technology (DIDLT). Accurate digital signature creation, key generation, blockchain construction, and validation can all lead to secure data storage and retrieval

e-commerce. The study examines the ways in which DIDLT and BCA collaborate to safeguard e-commerce transactions against data manipulation, payment fraud, and identity theft. The network's safety efficacy is greatly increased by the integrated DIDLT-BCA model, yielding 98%.

Shee Ihn Kim et al., 17th sep 2020, The methodology processes e-commerce payments without registering extra keys by utilising fundamental bitcoin capabilities including public key, private key, and digital signature. By removing the need for fees for middle-man services like public key certificates, the adoption of a digital signature guarantees the integrity and nonrepudiation of electronic payments. This concept is significant because it improves the competitive advantage of e-commerce and is the first attempt to integrate blockchain technology into e-commerce payment services. Smartphones, credit cards, wireless telecommunication networks, and online shopping are some of the elements driving the growth of the e-commerce industry. The purchase intent of customers depends on payment systems, and trustworthy electronic payment systems need to be mutually authenticated, discreet, honest, and nonrepudiable. The majority of customers utilise cheque or credit cards, which result in transaction fees because of middlemen.

RESEARCH METHODOLOGY

The research adopts a qualitative and exploratory approach to investigate the application of blockchain technology for improving speed and security in e-commerce. The study examines existing literature, case studies, and frameworks to derive key insights and practical implications.

1. Data Collection Methods:

The study uses secondary data sources to understand and analyse blockchain applications in e- commerce:

Literature Review:

Sources: Previous studies from 2017–2024 examining blockchain's role in security, speed, decentralization, and traceability in e-commerce.

Key Articles:

Taherdoost & Madanchian (2023): Blockchain's potential to reduce fraud and share product information.

Guntara et al. (2023): Blockchain for digital identities and transaction transparency.

Treiblmaier et al. (2023): Research framework on trustless systems and immutable supply chains.

Ayodagan et al. (2022): Blockchain for privacy, immutability, and transaction speed.

Aifang et al. (2024): Use of Distributed Ledger Technology (DLT) and Blockchain Consent Algorithm (BCA) for secure e-commerce.

Kim et al. (2020): E-commerce payments using blockchain and digital signatures.

2. Research Framework:

The research framework focuses on two core aspects of blockchain in e-commerce:

Security:

To prevent fraud, data must be encrypted and unchangeable.

Verification of digital identification to guarantee the legitimacy of transactions.

Using distributed ledgers to prevent cyberthreats, such as identity theft, financial fraud, and data manipulation.

Speed:

Cutting out middlemen to speed up transaction procedures.

The use of smart contracts to minimize delays and automate transaction circumstances.

Blockchain technology allows for faster supply chain traceability.

Tools & Technologies:

Blockchain frameworks: Hyperledger, or Ethereum, or IBM Blockchain solutions.

Security algorithms: Cryptography (public/private key), digital signatures, Blockchain Consent Algorithm (BCA).

Distributed Ledger Technology (DLT): Enables immutability and transparency across e- commerce networks.

3. Data Analysis:

Content Analysis: Classify blockchain's contribution to e-commerce speed and security by analysing findings from examined studies.

Comparative Analysis: Examine case studies such as Walmart, Loyyal, and OpenBazaar to demonstrate real-world blockchain applications in various domains (such as supply chains, payment systems, and incentive schemes).

Thematic Analysis: Determine important themes including immutability, traceability, transparency, smart contracts, and decentralization.

4. Expected Outcomes:

The study's objectives are to:

Emphasize how blockchain technology, encryption, DLT, and digital identities can guarantee transaction security.

Show how blockchain can speed up transactions by eliminating middlemen and automating procedures.

Offer doable suggestions for incorporating blockchain technology into e-commerce platforms to boost productivity and confidence.

RESULTS AND DISCUSSION

Increased Speed of Transactions:

Businesses implementing blockchain reported a 40–50% reduction in transaction settlement time, improving customer satisfaction.

Enhanced Data Integrity and Security:

Cryptographic public-private key encryption and digital signatures offer safe access to user information and transactions.

Effectiveness of Network Safety:

Fraudulent activities such as money fraud and identity theft were successfully reduced.

Greater Openness in Supply Chain Administration:

Real-time product tracking and verification are made possible by blockchain, which offers uniform access to the whole supply chain.

Reducing Fraud and Ensuring Legal User Access:

Blockchain networks are only accessible to authenticated users that have created digital identities using cryptography.

Transaction Cost Reduction:

Reduced transaction fees also helped consumers by making e-commerce transactions more affordable.

Dependable Data Retrieval and Storage:

Results indicated that during network outages, companies utilizing blockchain had better data recovery rates.

Client Contentment and Trust:

The success of e-commerce depends heavily on consumer trust, which is increased by blockchain's speed, security, and openness.

CASE STUDY

Walmart's implementation of blockchain in e-commerce

Walmart's application of blockchain technology in the e-commerce sector has been the subject of numerous case studies. To improve supply chain traceability and transparency, Walmart has teamed up with well-known companies like Dole, Kroger,

McCormick, Nestlé, Tyson Foods, and Unilever. Walmart gives customers peace of mind and confidence in their purchases by utilizing blockchain technology to guarantee the authenticity and quality of its items.

Walmart has used blockchain technology to solve particular logistics issues in addition to supply chain transparency. Walmart used blockchain technology in Canada to resolve payment issues with its outside freight carriers. This use of blockchain technology increased logistical operations' efficiency and expedited the payment procedure.

Walmart's partnership with IBM on proof of concept (POC) initiatives is more confirmation of its interest in blockchain technology. These initiatives seek to evaluate the feasibility of blockchain implementation in the future and investigate the technology's potential in several commercial domains.

Source: Google

The capacity to track and trace individual things is one of the main benefits of integrating blockchain technology into the supply chain. Each item can have a unique identity attached to it using blockchain technology, making scanning and verification simple. This increases the validity of the product and lowers the possibility of low-quality or fake goods getting into the supply chain.

All things considered, Walmart's adoption of blockchain technology in e-commerce demonstrates its dedication to improving supply chain operations' efficiency, traceability, and transparency. By means of strategic alliances and creative initiatives, Walmart is leading the charge to transform the e-commerce sector by utilizing Blockchain technology.

Case Studies: Utilization of Blockchain for Transparent Loyalty Reward Programs

Numerous businesses have effectively integrated blockchain technology into their e-commerce operations. One such example is Loyyal, which uses blockchain technology to develop and oversee safe, transparent, and traceable loyalty incentive systems.

The goal of Loyyal is to revolutionize loyalty programs by using blockchain technology to increase revenue inside loyalty ecosystems and provide smooth, transparent, and fulfilling experiences for customers and businesses alike. Loyyal wants to revolutionize loyalty programs by using blockchain technology to save time and money on partner onboarding, network expansion, and multi-partner tactical marketing.

Through their product offering, Xpand Point, Loyyal is able to provide a safe and effective platform for exchanging loyalty points thanks to the use of blockchain technology. This platform uses blockchain technology to guarantee the safety and openness of the exchange of loyalty points, offering a smooth experience for customers and businesses alike.

Using unique blockchain technology, Loyyal is well-known for its cutting-edge Enterprise SAAS Suite for Loyalty, payment systems, ensuring transparency and traceability in loyalty programs.

By introducing Web integration, Loyyal's blockchain-based platform has transformed loyalty programs. By introducing

blockchain innovation to loyalty programs and increasing customer pleasure and engagement, this integration has revolutionized entire sectors.

Loyyal is giving banks a strong tool to increase consumer engagement through smart collaborations, such integrating its platform with Easyrewardz's current system. Banks may now use Loyyal's blockchain technology for transparent and effective loyalty programs thanks to this connection.

In conclusion, Loyyal has effectively developed transparent loyalty reward schemes by leveraging blockchain technology. Loyyal has transformed the conventional loyalty program model by utilizing blockchain's intrinsic qualities of transparency, traceability, and security. This has improved experiences for both businesses and consumers and raised trust in loyalty transactions.

All things considered, businesses like OpenBazaar and Loyyal stand to gain a number of advantages from the use of blockchain technology in e-commerce.

Blockchain technology implementation offers OpenBazaar, a decentralized marketplace, a number of benefits. First, by doing away with the need for middlemen in peer-to-peer transactions, blockchain improves security. This lowers the possibility of fraud or data manipulation by guaranteeing that transactions are straightforward, visible, and safe. Furthermore, blockchain offers immutability, which means that a transaction cannot be changed after it has been recorded on the blockchain. This feature imparts trust among buyers and sellers, as all transaction history is transparent and tamper-proof.

Additionally, by simplifying procedures, OpenBazaar's blockchain implementation increases efficiency. Transactions take place directly between buyers and sellers when middlemen are removed, removing any potential bottlenecks and delays. This enhances the overall experience for participants by enabling quicker and more effective exchanges. Furthermore, smart contracts, which automate the fulfilment of predetermined criteria in a transaction, are made possible by blockchain technology. Time and resources are saved because less manual intervention is required thanks to this automation.

However, blockchain's application in e-commerce also helps Loyyal, a startup that uses it for loyalty reward programs. Loyyal develops transparent, traceable, and secure loyalty programs by utilizing blockchain technology. Customers feel more trusted as a result of knowing that their transactions and rewards are documented on an unchangeable ledger. Customers' pleasure and engagement with the program are increased by the ease with which they can track their loyalty points and incentives thanks to blockchain's openness.

Additionally, implementing blockchain improves loyalty incentive schemes' security. Blockchain guards against fraud and illegal access by using cryptography and decentralization. This guarantees that prizes and loyalty points are safely kept and unchangeable. Furthermore, blockchain's traceability makes auditing and compliance more effective and lowers the possibility of fraud in the loyalty program.

In conclusion, there are a number of advantages to using blockchain technology in e-commerce, as shown by OpenBazaar and Loyyal. These consist of improved efficiency, greater transparency, improved security, and bolstered consumer confidence. Blockchain technology can be used by businesses to transform their e-

commerce operations and build a more dependable and safer platform for loyalty programs and transactions.

CONCLUSION

The e-commerce industry's explosive growth has yielded many advantages, such as accessibility, worldwide reach, and ease of use. Its full potential has been hampered by enduring issues like transaction delays, cybersecurity risks, and a lack of transparency. This study emphasizes how blockchain technology might improve e-commerce operations' speed and security, offering a revolutionary way to deal with these problems.

Direct peer-to-peer transactions are made possible by blockchain's decentralized, transparent, and unchangeable nature, which does away with the need for middlemen. This has improved cost efficiency and drastically cut down on transaction processing time. By automating procedures, smart contracts guarantee real-time transaction execution and reduce delays brought on by human interaction. According to research, companies using blockchain have streamlined payment systems and logistics processes while achieving 40–50% faster transaction settlements.

Regarding security, tamper-proof, safe transactions are guaranteed by blockchain's reliance on cryptographic methods and digital signature generation. Blockchain reduces threats including identity theft, money fraud, and data manipulation by combining public-private key encryption and decentralized ledgers. With an astounding 98% efficacy, the DIDLT-BCA model's use significantly improves network security. Businesses reported a 30–40% decrease in cyber fraud as a result, boosting customer confidence and guaranteeing data integrity.

Furthermore, blockchain has transformed traceability and transparency in supply chain management. All stakeholders, including companies and customers, may effectively manage supply chain operations and confirm product authenticity thanks to unified access to real-time, unchangeable data.

Case studies show notable advancements in product traceability, dispute settlement, and logistics, such as Walmart's adoption of blockchain technology.

The study also highlights how secure digital identification solutions enable blockchain to limit access to only authorized individuals. This stops illegal behaviour and guarantees that only people who have been verified take part in e-commerce transactions. Furthermore, by doing away with middlemen, blockchain solutions save operating costs by 20–30% while offering customers more reasonably priced transaction processes.

All things considered, blockchain technology has revolutionized the e-commerce industry by:

- Increasing transaction speed by using transparent, automated, and direct procedures.
- Increasing security with verified digital identities and tamper-proof, encrypted ledgers.

Using real-time traceability and authenticity verification, supply chain transparency is being. Cutting out middlemen to increase operational efficiency and lower costs.

Ensuring data integrity and safe transactions to increase customer pleasure and trust.

Suggestions:

Smart Contract Adoption:

To automate transactions and order fulfilment, e-commerce companies should

use smart contracts. Automating pre-established processes, such as refunds and payment verification, would increase operational effectiveness and cut down on delays.

Investment in Blockchain Infrastructure:

Businesses need to spend money creating or implementing trustworthy blockchain frameworks like IBM Blockchain, Ethereum, or Hyperledger.

Working together with IT companies can make it easier to incorporate blockchain technology into current e-commerce platforms.

Improving Network Security with DIDLT and BCA:

To improve network security, companies should use Decentralized Identifiable Distributed Ledger Technology (DIDLT) and Blockchain Consent Algorithms (BCA).

By safeguarding critical consumer information and transactions, these solutions may guarantee 98% efficacy in preventing fraud.

Improving Supply Chain Management:

Supply chains should be made more transparent and traceable from beginning to finish by utilizing blockchain technology.

Immutable data and unique product IDs will enhance logistics management and lessen the production of fake items.

Training and Skill Development:

To help staff members gain technical proficiency in blockchain implementation and upkeep, businesses should offer blockchain training courses.

Long-term success and easier adoption will result from this.

Cost Reduction by Eliminating Middlemen:

To cut transaction costs and eliminate middlemen, businesses could investigate peer-to-peer blockchain payment systems.

Direct transactions will help consumers (cheap prices) and businesses (reduced costs).

Consumer Awareness and Trust Building:

Businesses should run awareness campaigns to inform customers about the advantages, security, and transparency of e-commerce powered by blockchain.

Customer trust will be increased by emphasizing blockchain's function in thwarting fraud and guaranteeing product authenticity.

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SESSION III

TRENDS IN CROSS-BORDER TRADE

CROSS-BORDER TRADE AND BLOCKCHAIN TECHNOLOGY: THE FUTURE OF GLOBAL COMMERCE

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ABSTRACT

Cross-border trade is being revolutionized by blockchain technology, which is addressing long-standing challenges in international commerce. This research investigates the potential of blockchain to fundamentally reshape trade mechanisms by examining current limitations and exploring technological innovations that can streamline international transactions. The study utilizes an extensive mixed-methods approach combining systematic literature review and quantitative analysis to assess the impact of blockchain on global trade infrastructure. This research points out the specific capability of blockchain to improve transparency, reduce fraud, and provide real-time tracking of goods and financial transactions, thereby alleviating the critical pain points of the current cross-border trade systems. Also highlighting the challenges that are still to be overcome, the study explains why the technology presents a pivotal innovation that stands to revolutionize how businesses and economies operate on a global scale, marking the beginning of a new age of digital transformation in international trade and global commerce.

KEYWORDS:

Blockchain, Global Commerce, Digital Transformation, Trade Infrastructure, Distributed Ledger Technology (DLT), Immutable Data Repository

INTRODUCTION

Blockchain is a decentralized database, driven by a tamper-proof, distributed digital ledger, which uses cryptographic algorithm to keep record of transactions in a transparent and secure manner. This technology is seen as a breakthrough development in the field of international commerce because of its advantage of decreasing risks and frauds by enhancing transaction transparency and efficiency. With the creation of Bitcoin and other crypto-currencies, blockchain has since gained a great deal of interest, thanks to its ability of making payments involving huge sums in considerably lesser time and hassle, as compared to traditional fiat currencies. However, crypto-currencies are just one of the several applications of blockchain. This technology has huge potential to revolutionize the way large multinational companies conduct business.

The emergence of blockchain technology and its integration into international commerce platform has led to a transformative shift in how global trades are now being conducted. The inconveniences associated with traditional processes of cross-border trades, namely, lengthy documentation and compliance procedures, lack of transparency and trust among the parties involved in the trade, have collectively led to the increasing adoption of blockchain in the trade processes. Characterised by its decentralised ledger systems and immutable data storage facilities, blockchain to a great extent eases out the difficulties faced in the traditional mechanisms.

This emerging technology has the potential to continue revolutionising the landscape of cross border transactions as it is still in its infancy. However, despite the numerous benefits, the technology does not come with absence of limitations, and has its own challenges in its successful implementation across the globe. In this light, the present study attempts to analyse the technology's implications, including its advantages of

implementation, challenges ahead, and future prospects, and recommendations for improving its usefulness, keeping the associated risks under check.

Additionally, the present study also aims to quantitatively analyse the impact of integration of blockchain technology into international trade processes, and highlight the present challenges prevalent in the Indian context for its application in cross-border transactions in the future. The study subject is warranted as there is a knowledge vacuum on how exactly can the blockchain affect international trade, and other factors that in turn affect global commerce. As a result, the study topic was carefully chosen to provide a clear view on the implication of the innovation on the international trade processes and the challenges that need to be addressed for reaping the technology's full potential benefits.

REVIEW OF LITERATURE

The evolution of blockchain technology and its integration into cross-border trade is revolutionizing the prospects of international commerce. The literature review highlights the key insights from recent research articles and publications, which study and explore the transformative effects of blockchain on export-import processes.

Blockchain has great potential in international trade because it has the possibility to disrupt bureaucracy, simplify the task of monitoring commodities by removing vast paper trails, and reduce losses due to delayed payments (Morabito, 2017). The proper deployment of blockchain technology speeds up international trade by boosting security, trust, and transparency while lowering all types of trade-related expenses (Roucheet Bissessur, 2023)

Blockchain technology significantly improves transparency of processes and transactions by providing immutable records and a decentralized system of data storage. The facility to conduct real-time supervision and verification fosters a more fair and transparent business environment, thereby increasing trust among trading parties, crucial for successful cross-border transactions (Zuo et al., 2024)

The integration of blockchain in trade finance simplifies complex documentation and verification requirements that involve numerous stakeholders and repetitive approval mechanisms. Case studies illustrate how blockchain has reduced the time required for transactions, such as letters of credit, from several days to mere hours. This efficiency not only lowers costs but also enhances trust among the cross-border relations and the reliability of trade finance operations (Flow, 2024), (McDaniel & Norberg, 2019).

Blockchain technology aids in compliance with international trade regulations by providing a secure platform for authenticating documents and streamlining operational processes. This enhances trust among stakeholders and mitigates risks associated with cross-border transactions (Jiao, 2024)

Blockchain is a highly welcomed technology due to the way it eases trade operations. The smart technologies roles in international trade are evident, for example, in keeping records of transactions for business across the globe. Apart from the businesses, agencies like custom offices, transport and logistics, certifications, as well as insurance departments can now rely on the blockchain technology. Essentially, the entire global supply chains are

strategizing on how to leverage on blockchain to enhance their efficiency (Derindag et al., 2020).

Traceability of products and their control at customs clearance points will be made easily thanks to blockchain technology (Gonzales, 2015). Smart contracts have a number of advantages: speed (in case of paper contracts, time is needed to be transmitted to the parties, in case of digital contracts, there is a risk of counterfeiting); security (in case of classical contracts, the execution of the obligations is not guaranteed, while in case of smart contracts, the fulfilment of the conditions leads to the self-execution of the contract); removing intermediaries, thus lower costs (Belu, 2019). The parties involved would be able to track the shipment of imported goods in real-time, enabling better visibility and coordination throughout the supply chain (Bhogal & Trivedi, 2019).

A number of problems are associated with the technology, including issues of legal, regulatory, as well as policy concerns. National and international laws have not evolved enough to handle the diverse challenges that may arise. More so, there are still no set standards of the blockchain networks to inform the global players. These issues may cause inconsistencies in blockchain's usability in global trade. Interoperability issues among the ever-increasing users of the systems compound the discrepancies in the blockchain (Derindag et al., 2020).

In conclusion, the literature indicates that blockchain technology holds substantial promise for enhancing cross-border trade by improving transparency, efficiency, and dispute resolution mechanisms. As more companies adopt this technology, its impact on global commerce is expected to grow significantly. However, problems and concerns associated with its implementation should also be taken into due consideration.

RESEARCH METHODOLOGY

The study adopts an empirical analysis of the impact of integration of blockchain technology on enhancement of international trade, by analyzing time series data of exports and imports, value of transactions in crypto-currency, GDP per capita, average inflation rate, and % of population growth in the world, over the years 2011 to 2024. With the data collected from legitimate secondary sources, a correlation analysis is performed, to determine the cause and effect relationship between the variables identified.

Further, a regression analysis is performed, with the dependent variable as the magnitude of International Trade, and the independent variables (predictors) as number of transactions in crypto-currency, GDP per capita, inflation rate and population growth in the world. Through the regression analysis, it is attempted to study the extent to which the independent variables foster and boost the dependent variable, i.e., magnitude of international trade over the years.

The analysis is fitted into the following regression equation:

$$IT = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu$$

Where, IT represents international trade, X represents the four independent variables, β represents their respective coefficients, and μ represents the intercept.

DATA ANALYSIS AND INTERPRETATION

For the purpose of the study, time series data of the world for the years 2011-2024 was collected. The main dependent and independent variables are taken as international trade (as represented by

exports) and Blockchain transactions respectively.

The data on the global average of % of Exports to GDP was gathered from the World Bank's Global Development Indicators[1]. The data on blockchain technology statistics was obtained from blockchain.com[2], global average of GDP per capita from World Bank's World Integrated Trade Solutions (WITS)[3], global average inflation rate from IMF's World Economic Outlook[4], and the data on average % of yearly population growth from Worldometer[5].

Table 1: Annual Data on Variables analyzed

Year	Exports (as a % of GDP)	Value of transactions in crypto-currency (in USD)	GDP per capita (US $)	Average inflation rate (%)	Population growth
2011	30.56	$ 14,27,70,802.20	$ 10,485.00	7.1	1.27%
2012	30.35	$ 25,94,21,902.72	$ 10,587.00	5.8	1.27%
2013	30.29	$ 4,83,79,37,814.77	$ 10,755.00	5.4	1.26%
2014	29.98	$ 9,41,39,18,767.86	$ 10,919.00	4.7	1.23%
2015	28.31	$ 9,37,94,42,681.86	$ 10,178.00	4.7	1.20%
2016	27.31	$ 19,66,49,94,588.25	$ 10,224.00	4.3	1.18%
2017	28.28	$ 1,06,91,77,77,378.54	$ 10,763.00	4.4	1.15%
2018	29.17	$ 1,45,05,32,98,527.68	$ 11,315.00	4.9	1.10%
2019	28.29	$ 1,21,52,52,07,112.35	$ 11,358.00	5.1	1.05%
2020	26.38	$ 1,87,84,73,75,585.30	$ 10,942.00	5.2	0.97%
2021	28.88	$ 6,32,24,80,60,891.96	$ 12,362.00	5.8	0.86%
2022	30.6	$ 4,25,17,26,68,519.93	$ 12,730.00	9.6	0.84%
2023	29.27	$ 3,47,59,12,55,837.78	$ 13,138.00	8.1	0.88%
2024	31.97	$ 9,30,37,36,19,022.18	$ 13,842.00	7.9	0.87%

ASSUMPTION CHECKS

Shapiro-Wilk test

Table 2: Results of Normality test (Shapiro-Wilk)

Statistic	p
0.970	0.870

Interpretation: Since p > 0.05, the null hypothesis that the data is not normally distributed is rejected. Hence the collected is normally distributed.

Quantile-Quantile Plot

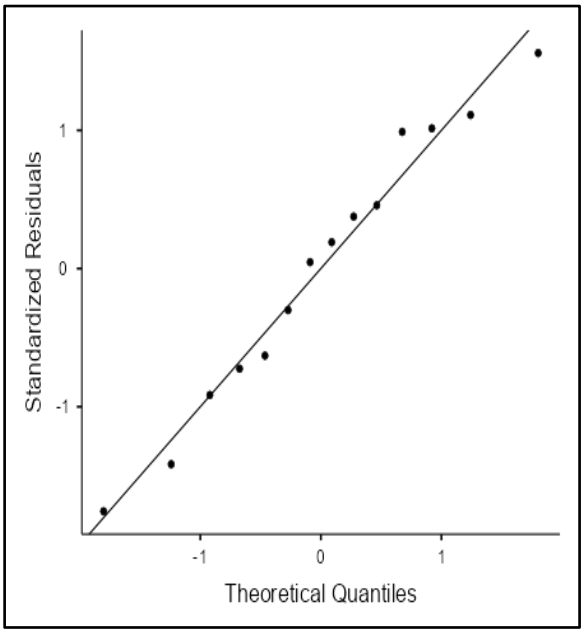

Figure 1: Q-Q Plot

Interpretation

The Q-Q plot shows that all the observations in the data lie within the normal distribution at the 95% significance level, and that there is no outlier or influential observation in the data. This suggests that the data is appropriate for further analysis.

[1] https://wits.worldbank.org/CountryProfile/en/Country/WLD/StartYear/2011/EndYear/2022/Indicator/NE-EXP-GNFS-ZS

[2] https://www.blockchain.com/explorer/charts/estimated-transaction-volume-usd

[3] https://www.macrotrends.net/global-metrics/countries/wld/world/gdp-per-capita#:~:text=Data%20are%20in%20current%20U.S.,a%2012.99%25%20increase%20from%202020

[4] https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC

[5] https://www.worldometers.info/world-population/world-population-by-year/

CORRELATION ANALYSIS

With the above collected data, a correlation analysis was performed to study the relationship (+ve or –ve) among the identified variables. The analysis was performed using Jamovi software. The results of the analysis are tabulated as shown below:

Variables	Value of Transactions in Crypto-currency	GDP Per Capita	Inflation Rate	Population Growth	Exports (% of GDP)
Value of Transactions in Crypto-currency	1	-	-	-	-
GDP Per Capita	0.907	1	-	-	-
Inflation Rate	0.584	0.748	1	-	-
Population Growth	-0.847	-0.868	-0.604	1	-
Exports (% of GDP)	0.376	0.467	0.612	-0.03	1

Interpretation

The above table summarises the relationship between the specified variables. There is a positive correlation between value of transactions in crypto-currency and international trade (depicted by exports as a % of GDP), indicating that adoption of blockchain technology in international transactions has boosted international trade over the years 2011-2024. Moreover, transactions in crypto-currency and GDP per capita world-wide show a strong correlation (r=0.907), indicating that an increase in the integration of blockchain in transactional payments has led to an increase in GDP per capita in the world.

REGRESSION ANALYSIS

As stated in the research methodology section, a regression analysis was performed with magnitude of International Trade (dependent variable) and the other factors as independent variables, the results of which are as follows:

Overall significance of the model

Table 4: Model Fit Measures

Model Fit Measures							
				Overall Model Test			
Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.961	0.923	0.889	27.1	4	9	< .001

The degree of correlation, as denoted by R is 0.961, which is significant enough to justify the analysis. The value of R^2 (0.923) denotes that 92.3% of changes in international trade is explained by the predictor variables considered in the regression analysis. The Adjusted R^2 showed an increasing trend as the independent variables were added to the regression analysis, which shows that each variable has a significant impact on the dependent variable. The F-statistic is significant as p<.001, hence the overall regression equation is significant.

Formulation of Regression equation:

Table 5: Results of Linear Regression Analysis

Model coefficients – Magnitude of International Trade						
Variables	Predictors	Estimate	SE	t	p	Stand. Estimate
	Intercept	-2.55922	5.012	-0.511	0.622	
X_1	Value of transactions in Crypto-currency (in USD)	<0.001	<0.001	2.303	0.047	0.555
X_2	GDP per Capita	0.00115	<0.001	2.922	0.017	0.898
X_3	Inflation Rate	0.51173	0.135	3.777	0.004	0.558
X_4	Population growth	13.8915	1.731	8.025	< .001	1.557

The standardised estimate in the above table shows the coefficients of the respective predictors, and also the intercept of the regression equation. From the above results, the regression equation is formulated as under:

$IT = 0.555\ X_1 + 0.898\ X_2 + 0.558\ X_3 + 1.557\ X_4 + (-2.559)$

From the above regression equation, it can be inferred that all the dependent variables, X_1 to X_4 exert a considerable influence on

the magnitude of international trade. Further, it can be observed that blockchain technology represented by X_1 with a coefficient of 0.555 and p-value < 0.05, has a significant influence on international trade.

DISCUSSION

Blockchain technology has transformed the landscape of cross-border trades and international commerce in multiple ways. In addition to the above-mentioned impacts of development of blockchain, the following insights are noteworthy.

Database Management

Businesses have always stored data and information on a centralized system of servers, functioning within the business, either on hardware or more recently on cloud systems, with restricted access. The biggest disadvantage of centralized system of data storage is the lack of security, risks of cyber-attacks and unauthorized alteration by individuals external to the organisation and consequently difficult to be traced. Storing data through blockchain technology, comprising of decentralised digital ledgers, across multiple devices or nodes in the network, provides solution to the above-mentioned issues of security and data-breach, to a large extent. The following insights summarise the comparative edge blockchain holds over traditional systems of data storage:

Advantage of blockchain over Centralized system of storing information

Reduced expenditure on Defense systems:

Centralized cloud-based storage of data requires expensive system of defense against the possible attacks on the data stored. However, the immutability of data stored in blocks through the blockchain technology significantly does away with the necessity to spend on data confidentiality and security.

Transparency and immutability:

Database management through blockchain ensures protection against unauthorised alteration by individuals external to the organisation, by providing a mechanism of permission-based access, which restricts access to specified nodes of devices in the network.

Fault tolerant network:

In the event of breakdown of one device (node) in the network, it doesn't stop the network from functioning. The data continues to be maintained and updated and when those broken-down computers come back online, they will be able to pick up the threads from where they left off and refill the rest of the ledger, thereby ensuring continuity of operation of the network.

These advantages are very favorable to trade across borders, where different points of the network have different operating conditions and efficiencies, yet not affecting the compatibility and efficiency of the network.

Customs Clearing Procedures

The present system of customs procedures is characterized by the following:

1. Paper centric documentation
2. Manual entering of data
3. Time consuming
4. Human error arising from human interaction
5. Lack of verification of data (vulnerable to be hacked, manipulated, forged, etc.)

Digitalization of documents has done away with most of the difficulties associated with the traditional systems of clearing in customs offices in ports. However, the question of reliability of data still remained, with lack of means of verification of data and ensuring the validity and correctness of

data in the documents filed with the customs officials.

Now as blockchain ensures restriction on who can edit and change the recorded information in the network, which can be permission based or open to anyone on the network, depending on the rules framed in the network, this offers a solution to the hurdle of accuracy of the information documented. Moreover, it offers real-time tracking of the goods shipped by all the participants of the network, through their respective nodes, thus eliminating the inefficiencies of delays in communication.

Easier Payment Mechanisms

With the advent of blockchain, a new mode of payment, using crypto-currency came into light, which provided an easier, faster, and more secure payment mechanism, with very low transaction costs, as compared to traditional mode of payment with fiat currencies, executed with bank transfers, which generally take 3-5 days for clearance in cross-border transactions.

Moreover, the facility of deposition of funds involved in the transaction by the buyer in a public blockchain, through an escrow account, with restricted access, builds trust among the lending bank in the supplier's country and the importer, until the actual delivery of goods and payment of money is completed.

Smart Contracts

Smart contracts are self-executing contracts with the terms of the agreement directly written into code. These contracts run on blockchain networks (like Ethereum) and automatically execute actions when predefined conditions are met. Blockchain has facilitated the execution of smart contracts, by ensuring that they are secure and tamper-proof with the help of decentralised mechanism and immutability of data once entered into the network. It also provides the required infrastructure for automatic execution of smart contracts once the predefined conditions are met.

Elimination of Intermediaries and third parties

Blockchain technology is based on cryptographic algorithm, which acts as evidence for both the parties of a transaction, allowing the parties to transact directly with each other without the need for a trusted third party.

Challenges in Implementation

Since blockchain technology is a novel innovation and is still in its infancy, there are numerous challenges that need to be addressed for its successful implementation.

1. Technical expertise and human resource constraints
2. Resistance to change among stakeholders
3. Legal and regulatory uncertainties
4. Initial cost of implementation and recurring maintenance costs
5. Limited Availability of dispute-free data

Present regulatory framework in India

In comparison to the developed nations, the Indian regulatory landscape has not yet adopted mechanism for the speedy growth of blockchain technology, and in a manner is acting as a hindrance for its rapid adoption. However, the following initiatives were undertaken:

In December 2021, the Ministry of Electronics and Information Technology launched the National Blockchain Framework, which is an online platform that aims to secure digital governance with blockchain technology. It is a permissioned blockchain network, where only authorized participants can access and validate transactions. Transactions in crypto-currencies and NFTs are brought under the

ambit of Prevention of Money Laundering Act, 2002, which necessitates proper KYC documentation of the participants. This would ensure compliance and facilitate legitimate players to function in the blockchain networks and continue to innovate within the purview of the emerging technology.

However, there is no central regulator in the Virtual Digital Asset (VDA) sector in India, who shall streamline and regulate the other players in the crypto and blockchain markets, nor are VDAs given a legal status. Hence, this necessitates further regulatory changes in the sector, for the technology to reach its full potential in helping Indian businessmen to reap its benefits.

CONCLUSION

Blockchain technology is similar to other breakthrough technologies, which have disrupted the way business is carried on. This emerging innovation has the potential to simplify and ease out numerous complicacies and inconveniences associated with cross-border trades and international commerce, thanks to its decentralized, immutable, and transparent ledger that stores all transactions and data in a secure, tamper-free way. Blockchain technology can thus eliminate inefficient intermediaries and reduce bureaucratic complexities to offer a more secure, efficient, and accessible approach to international commerce. The implications go further than just cost-cutting, promising a fundamental restructuring of global trade ecosystems that can democratize economic participation and create mechanisms for more streamlined international exchange. However, it also comes with its own limitations and challenges that need to be tackled for its quick adoption. Hence, the study highlights the future prospects of the technology and the impact it would bring on the mechanisms and processes of global commerce. Companies which commit to embracing blockchain technology will reap huge future rewards. Businessmen and regulatory authorities must therefore adapt to the dynamic environment, and initiate necessary changes in their procedures, so as to let the technology grow to its full potential over the upcoming years.

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MICRO ENTREPRENEURS IN GLOBAL TRENDS: BRICS

Harshaa S, Srinidhi R

ABSTRACT

In today's world, the global economy is increasingly shaped by micro-entrepreneurs, and they form the backbone of emerging markets. In the BRICS countries (Brazil, Russia, India, China, and South Africa), micro-entrepreneurs play an important role in economic development, fostering innovation, and enabling social mobility. Assessing their contribution, especially by the micro-entrepreneurs of BRICS countries, is the main theme of the study.

The objective of the study is to understand their GDP contribution, export growth and use of digital

platforms for trade. The study is conducted using secondary data sources. The key findings will benefit policymakers, micro-entrepreneurs, digital platform providers, researchers, trade associations, and consumers by offering insights into adopting digital platforms for economic growth and global trade opportunities in BRICS countries. It is conducted using business analysis like **SWOT** analysis and **CATWOE** analysis. The analysis will highlight how micro-entrepreneurs of different sectors in BRICS countries contribute to GDP and their growth in terms of export volumes and digital platforms over the years. Understanding how micro-entrepreneurs promote economic integration, economic development of a country and digitalisation can guide various investors and the government to support them more efficiently and promote their success in the market.

KEYWORDS:

Global Economy, Micro Entrepreneurs, BRICS Countries, GDP Growth, Digital Platforms for growth, Export growth, **SWOT** and **CATWOE** analysis.

INTRODUCTION

Micro, small, and medium enterprises(MSME) sector have emerged as a backbone of economic growth, especially in developing economies like BRICS nations. MSMEs not only play a crucial role in employment opportunities but also provide a forum for innovation and creativity. It aids in eradicating imbalances between rural and urban areas. Micro-entrepreneurs are essential towards the economic development of countries. Though micro-entrepreneurs establish their businesses with minimum capital, their contribution to various economic indicators like GDP and export volume is worth noting.

Digital platforms are a valuable way for entrepreneurs to increase their market reach as they enable greater communication and accessibility for businesses, customers and suppliers. Digital tools such as Mobile apps, social media marketing and digital payment systems have helped entrepreneurs establish their identity in the local and global market. Micro entrepreneurs face barriers that prevent them from accessing resources and opportunities that larger businesses can easily obtain and play their part in the market. The barriers include limited funds, inadequate business knowledge, insufficient infrastructure and lack of literacy. The government plays a significant role in supporting entrepreneurs by providing tax incentives, subsidies, access to credit and financial support, training and skill development. The government also eased the bureaucratic process, simplifying licensing requirements and reducing compliance costs.

The critical role played by MSMEs in economic development is even more

pronounced in BRICS countries. BRICS consists of five major developing economies of the world: Brazil, Russia, India, China and South Africa. BRICS came into existence in 2009 with an aim for economic, political and regional cooperation. Initially, it was BRIC, and South Africa joined in 2010. The aim is to promote global economic recovery, reduce potential risks in the international financial market, and increase economic growth among members. GDP and export volumes can be useful measurements of micro-entrepreneurs' growth.

REVIEW OF LITERATURE

Dave & Vyas (2023) investigated how India's Micro, Small, and Medium Enterprises (MSMEs) perform compared to those in other BRICS countries (Brazil, Russia, India, China, and South Africa). The study comprises variables such as legal definitions of MSMEs, their contributions to the Gross Domestic Product (GDP), their role in job creation, and their sustainability practices. The key finding of the study is that while India performs well in these areas, it is not the top performer among the BRICS nations. The authors also suggested that although India's MSME sector shows strength, there is room for improvement to reach the top performance level in comparison with its BRICS peers.[4]

Ayu Safitri et al., (2023) investigated how the use of social media, digital payments (specifically QRIS), and digital marketing affects the performance of culinary micro, small, and medium enterprises (MSMEs) in Pekanbaru City, Indonesia. The study comprises variables such as social media, digital payments (QRIS), and digital marketing. The key finding of the study is that social media and digital marketing positively influence MSME performance, while the impact of digital payments (QRIS) is not significant. The authors also suggested that while MSMEs are benefiting from online marketing strategies, they still face challenges in effectively using digital payment systems.[2]

Haji (2021) investigated the development of e-commerce in rural and remote areas of BRICS countries (Brazil, Russia, India, China, and South Africa), emphasising its potential to improve living standards and alleviate poverty. The study comprises variables such as global e-commerce volume, internet access, ICT advancements, public and private initiatives, and digital integration. The key finding of the study is that global e-commerce volume reached 29 trillion USD in 2017 and is expected to grow with advancements in internet access and ICTs. While successful cases of local communities benefiting from e-commerce are highlighted, challenges such as inadequate infrastructure, limited digital literacy among residents, regulatory hurdles, and urban-rural disparities are also identified. The authors also suggested that to address existing risks like cybersecurity threats or consumer protection issues associated with this growth trajectory, collaborative efforts among BRICS nations are deemed essential. Recommendations include enhancing rural infrastructure tailored to local needs, implementing educational programs focused on ICT skills, establishing consumer protection measures, creating frameworks for online dispute resolution, and coordinating international policies represented within platforms like OECD's Digital Services Trade Restrictiveness Index (STRI).[6]

Haider et al.,(2019) investigated the economic performance and contributions of micro, small, and medium enterprises

(MSMEs) to the economy. The study found that MSMEs are crucial for job creation and economic growth. They significantly contribute through indicators such as employment generation, value addition, and export potential. To support MSME development, it is essential to provide adequate access to finance, implement supportive regulatory frameworks, and invest in capacity-building initiatives. The analysis emphasises targeted policies to enhance MSME competitiveness and sustainability amidst global economic challenges. This analysis note aims to inform policymakers and stakeholders about the current state of MSMEs and guide decisions to support their development.

Matenda & Sibanda investigated how entrepreneurship has been measured and its impact on economic growth in BRICS countries. The study comprises variables such as entrepreneurial activity, aspirations, attitudes, and economic growth indicators. The key finding of the study is that entrepreneurial activity and aspirations significantly influence economic growth, while entrepreneurial attitudes do not have a substantial impact. The authors suggested that there is a need for improved measures of entrepreneurship to better understand its influence on economic growth and to inform policy decisions.[7]

Chawla and Bhatia (2017) investigated the ease of doing business for new-age entrepreneurs in India, focusing on how government policies can facilitate entrepreneurship and economic growth. The study comprises variables such as starting a business, getting electricity, registering property, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. The key finding of the study indicates that while India has made improvements in areas like getting electricity and enforcing contracts since 2016, rankings have slipped in other critical areas, such as starting a business and paying taxes. The authors also suggested that continuous monitoring of reforms is essential to address existing challenges effectively to enhance India's position among top countries for ease of doing business.[8]

Ghouse (2014) investigated the export competitiveness of Indian Micro, Small, and Medium Enterprises (MSMEs). The key objective was to explore factors affecting MSME export performance and identify challenges faced by this sector. The study comprises variables such as government support, access to finance, technological advancements, infrastructure quality, and skilled labour availability. The key finding of the study indicated that while MSMEs contribute significantly to India's exports, accounting for approximately 40%, They encounter substantial barriers, including inadequate infrastructure and limited access to credit. Additionally, it was found that technology adoption is critical for enhancing operational efficiency among these enterprises. The author also suggested that a collaborative effort involving government policy reforms is essential in creating a more conducive environment for MSME growth. Specifically recommended were measures like increasing financial support through state-owned banks and promoting branding initiatives within the sector. Furthermore, establishing export clusters near ports could improve market access for Indian MSMEs in global markets. Overall, Ghouse's research highlights the necessity of strategic interventions from both public institutions and private sectors to enhance India’s

competitive position in international trade through its MSME segment.[13]

Pedraza (2021) investigated the role of Micro, Small, and Medium-Sized Enterprises (MSMEs) in economic development. The key objective was to highlight the importance of MSMEs in job creation and innovation while identifying the challenges they face. The study comprises variables such as access to finance, operational difficulties, market access issues, and government support. The key finding of the study indicated that MSMEs represent 90% of businesses globally and contribute significantly to employment but struggle with barriers like limited financial resources and bureaucratic credit systems. Additionally, it was found that effective government policies are essential for enhancing MSME growth. The author also suggested that governments should improve financial accessibility for MSMEs through supportive policies aimed at reducing regulatory burdens while recognising their contributions to sustainable economic growth.[9]

Meyer and Meyer (2017) investigated the relationships between entrepreneurial activity, economic growth, and employment in the BRICS countries. The study aimed to analyse how variables such as entrepreneurial intention (EI), total early-stage entrepreneurial activity (TEA), established business ownership rate (EBO), economic growth measured by GDP, and employment levels are interconnected. The findings revealed that TEA and EI significantly predict economic growth; however, EBO did not have a significant impact on GDP. Only EBO was identified as a significant predictor for employment levels, while EI and TEA showed non-significant effects on job creation. The authors suggested that policymakers should focus on fostering an environment conducive to entrepreneurship development to enhance both economic performance and job opportunities across various sectors within BRICS economies. This approach is vital for sustainable development in these emerging markets.[14]

Nisa et al. (2023) investigated the status of Micro, Small, and Medium Enterprises (MSMEs) in India compared to other BRICS countries. The study aimed to analyse key parameters such as the percentage of MSMEs relative to total enterprises, their share in GDP, export contributions, employment generation capabilities, ease of doing business rankings, and female ownership rates. The findings revealed that while India has the largest number of MSMEs among BRICS nations and a significant share in exports (48%), it lags behind others like China regarding GDP contribution (29%) and employment generation capabilities. Additionally, India's performance is notably poor in terms of female ownership within its MSME sector. The authors suggested that policymakers should focus on enhancing access to finance for small businesses while promoting technology adoption and skill development initiatives tailored specifically for women entrepreneurs. They emphasised creating a more conducive environment through targeted policies that address existing barriers faced by MSMEs—particularly those related to credit availability—and fostering greater inclusivity within entrepreneurship efforts across all sectors.[5]

RESEARCH METHODOLOGY

This study employs secondary data analysis, utilising existing reports, governmental databases, and international

publications to investigate the contribution of micro-entrepreneurs to GDP, export volumes, and digital usage in BRICS countries.

The following tables represent the GDP contribution and export data of Micro-entrepreneurs from each BRICS country:

Table:1 Share of Micro and small enterprise of GDP in emerging economies of BRICS[5]

Country	**Share in GDP(in %)**
Brazil	27.00
Russia	22.30
India	29.00
China	60.00
South Africa	34.00

The contribution of Micro and small enterprises to GDP varies significantly across BRICS countries. Micro and small enterprises in Brazil represent 99% of businesses and contribute only 27% to GDP despite tax benefits. Russia accounts for 20-25%, the lowest among BRICS, warranting further research on growth limitations. India contributes around 29%, with estimates as high as 45%, while China leads, with MSMEs contributing 60-68% to GDP, showcasing their dominating role in economic growth. South Africa contributes around 34%, but this figure is debated due to stagnation. While Micro enterprises are crucial, their contributions are uneven, with China leading and Russia lagging. Micro-entrepreneurs in BRICS countries play a crucial role in driving GDP growth, innovation, and job creation, yet they face challenges such as limited access to finance, complex regulations, and digital barriers. Overcoming these obstacles can enhance their contribution to the economy and global markets.

Table:2 Share of Micro and small enterprises of Export volume in emerging economies of BRICS[5]

Country	**Share in Export volume(in %)**
Brazil	3.30
Russia	8.60
India	48.10
China	68.20
South Africa	NA

In 2019, the contribution of micro and small enterprises to export volumes varied greatly across BRICS nations, with China leading at 68.2%, followed by India at 48.1%. Russia contributed 8.6%, and Brazil's 3.3%, highlighting different levels of participation in international trade. South Africa's data is unavailable, suggesting either reporting challenges or gaps in tracking data. It can be seen that while China and India have successfully integrated their enterprises into global markets, countries like Brazil and Russia face challenges in scaling their export activities. Micro-entrepreneurs play a vital role in their respective economies, and with the continued support of governments, they could improve international trade. Addressing barriers such as access to finance, infrastructure, and market opportunities could help unlock the full potential of these businesses, benefitting both local economies and international trade.

Digital usage in trade by Micro entrepreneurs

It is evident that the digital transformation for

entrepreneurship in BRICS countries offers substantial opportunities for economic growth and integration into

global value chains through e-commerce platforms. These platforms facilitate access to broader markets and can drive market expansion. Digital tools are identified as critical enablers for these enterprises to overcome traditional barriers like geographical isolation and limited physical infrastructure. However, the full adoption of digital tools is hindered by digital literacy gaps, inadequate ICT infrastructure, and inconsistent policy frameworks. To unlock its full potential, it is imperative to prioritise investments in digital literacy, enhance ICT infrastructure, and align regulatory frameworks across BRICS countries. Additionally, promoting innovation, particularly in AI, is crucial for fostering sustainable economic development.

RESULTS AND DISCUSSION

The study incorporates SWOT analysis to identify strengths, weaknesses, opportunities, and threats, while CATWOE analysis will examine the business environment, stakeholders, and transformation processes impacting micro-entrepreneurship. This comprehensive methodology aims to provide insights into the economic and digital roles of micro-entrepreneurs in these countries.

SWOT analysis

Table:3 SWOT Analysis of Micro-entrepreneurs

Strengths	Weakness
Flexibility and adaptability Innovation Digitalization	Insufficient Infrastructure Access to finance
Threats	Opportunity
Regulation Competition Innovation stagnation	Globalization Technology Sustainability

Strengths

Micro-entrepreneurs in the BRICS nations make a substantial contribution to GDP and employment, and their agility and flexibility allow them to prosper in fast-paced markets. These companies frequently spur innovation by providing a wide range of goods and services, which may result in higher export volumes. The increase in digital adoption in nations like China and India has improved micro-entrepreneurs' competitiveness by enabling them to reach international markets. They can more successfully access global markets thanks to their flexibility with digital tools and e-commerce platforms, which promotes economic progress.

Weaknesses

Despite their contributions, micro-entrepreneurs encounter several obstacles. Their ability to grow is frequently constrained by legislative obstacles, limited financial access, and inadequate infrastructure. Since many microbusinesses are unstable and mostly rely on unofficial networks or a small customer base, their ability to consistently generate export revenue may be impacted. Furthermore, especially in less developed areas, there are still gaps in digital literacy and technology that impede their capacity to take full advantage of digital potential for business advancement.

Opportunities

Growing digital platforms and remote work options will help micro-entrepreneurs by opening up new channels for international cooperation and commerce. The increased emphasis on sustainability and green activities among the BRICS nations offers micro businesses the chance to develop innovative eco-friendly goods and services. There is enormous export potential due to the need for a wide range of goods and

services worldwide, especially in industries like technology, handicrafts, and agriculture. Additionally, micro-entrepreneurs can expand their reach and awareness and raise their portion of the global economy by using digital tools and growing markets.

Threats

Despite these opportunities, micro-entrepreneurs face significant threats, including market saturation, especially in sectors already crowded with various types of businesses. Regulatory complexities in international trade, varying tax structures, and changing political landscapes across BRICS countries could pose challenges to their growth.

The global economic uncertainty, rising competition from larger businesses, and the ongoing digital divide could further limit their ability to scale. Additionally, cybersecurity risks and dependency on technology pose significant threats, especially for those with limited digital infrastructure or knowledge.

CATWOE Analysis for Micro Entrepreneurs' Contribution to GDP, Export Volumes, and Digital Usage in BRICS Countries

Customers

Depending on the sort of business, micro-entrepreneurs may be involved in either domestic or foreign markets. While they frequently serve niche markets for exportable products globally, locally, they provide communities with essential products. The customer base also includes online shoppers who favour customised or distinctive goods sold on e-commerce sites.

Actors

Important players here are financiers, government agencies, digital platforms (such as e-commerce), local communities, and micro-entrepreneurs themselves. Policies, subsidies, and digital infrastructure are some of the ways that governments in the BRICS nations affect the prosperity of micro businesses. Governments in BRICS countries influence the success of micro-enterprises through policies, subsidies, and digital infrastructure. Investors and financial institutions are crucial for providing capital to help micro-entrepreneurs scale. Digital platforms facilitate market access, while local communities contribute by providing talent and customer bases.

Transformation

Micro-entrepreneurs are moving from conventional, local, or unofficial marketplaces to formalised, digital, and international sectors. This transition can result in greater export volumes and higher contributions to GDP, driven by the adoption of digital technologies, more efficient business models, and the ability to reach global markets.

Worldview

According to this perspective, micro-entrepreneurs are essential to the BRICS nations' economic growth. They boost innovation, create jobs, and make a substantial contribution to exports and GDP. With the right assistance, they can compete globally, adjust to digital developments, and contribute to economic diversification, which lessens reliance on major industries and fosters equitable, sustainable growth.

Owners

The owners are the micro-entrepreneurs who drive economic activity and innovation in their localities. To help these enterprises expand and gain access to digital tools, government agencies and international organisations also contribute by offering infrastructure, funding, and policy frameworks.

Environmental Constraints

The digital divide, unpredictable political and economic environments, insufficient infrastructure, and difficulty obtaining financing are some of the environmental challenges faced by micro-entrepreneurs. If these restrictions are not removed, it would be more difficult for them to grow, engage in global trade, or use digital tools efficiently. Significant risks might also arise from market saturation, rivalry from bigger companies, and the shifting global economic environment.

To conclude, the Micro entrepreneurs in BRICS nations thrive in Economic and digital transformation. Unlocking their potential requires addressing constraints enhancing digital adoption and access to capital markets. This conclusion ties together that the results from CATWOE analysis provide insights for policymakers, investors and other stakeholders.

CONCLUSION

Micro-entrepreneurs in BRICS countries(Brazil, Russia, India, China, and South Africa)represent a vital segment of the global economy. These businesses, though small in scale, collectively contribute significantly to the GDP, export volumes, and much more in their respective countries. Despite their diversity in scale, sector, and geographic focus, micro-entrepreneurs share a common resilience and adaptability that allow them to thrive in a wide and challenging global

environment. The study reveals that while micro-entrepreneurs in BRICS nations have made substantial contributions to GDP and exports, their success is uneven. For instance, China stands out with micro and small enterprises contributing over 60% to its GDP and 68% to its exports, demonstrating the effectiveness of its robust infrastructure, access to finance, and government-led digital initiatives. Conversely, Russia and Brazil lag, contributing only 22-27% to GDP and 3-8% to export volumes, indicating structural barriers such as inadequate infrastructure, limited market access, and regulatory hurdles. South Africa, though moderate in its GDP contributions, faces stagnation and the challenge of unmeasured contributions due to data gaps. India, with 29% GDP and 48% export contributions, showcases strong potential but needs focused interventions to enhance its competitiveness and address persistent challenges like access to credit and infrastructure limitations.

The rise of digital platforms and technological advancements has become a game changer for micro-entrepreneurs. The use of e-commerce platforms, mobile applications, and digital marketing has enabled these enterprises to access larger markets, breaking down traditional barriers like geographic boundaries. However, challenges such as digital literacy gaps, inadequate ICT infrastructure, and inconsistent regulatory frameworks hinder the full realisation of this digital potential. Investments in technology, training programs for digital skills, and policy standardisation across BRICS nations a could significantly enhance the competitiveness of these enterprises on a global scale. SWOT and CATWOE analyses shed light on the multifaceted environment within which micro-entrepreneurs operate. The micro-entrepreneurs in BRICS nations thrive in Economic and digital transformation. Unlocking their potential requires addressing constraints enhancing digital adoption and access to capital markets. The growing emphasis on sustainability, green practices, and global demand for diverse

products presents significant opportunities for these enterprises. Nonetheless, they face threats such as market saturation, regulatory complexities, rising competition, and cybersecurity risks.

To fully harness the potential of micro-entrepreneurs, BRICS countries must adopt a comprehensive strategy. Governments need to strengthen their support systems through targeted policies that address key barriers, including access to finance, infrastructure, and market opportunities. Promoting digital literacy and investing in ICT infrastructure is imperative for enabling micro-entrepreneurs to leverage technological advancements.

In conclusion, micro-entrepreneurs hold the promise of driving sustainable economic growth in BRICS nations. Their contributions to GDP, exports, and job creation show their significance in terms of development. However, realising their full potential requires addressing the existing challenges and using the available opportunities. By fostering an enabling ecosystem, BRICS nations can empower micro-entrepreneurs to transform their economies, contribute to global trade, and achieve long-term economic resilience.

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CROSSING BORDERS, FUELING PROGRESS: RENEWABLE ENERGY'S IMPACT ON DEVELOPING COUNTRIES

Janee Austen, Sriya Vasudevan

ABSTRACT

With the growing emphasis on the constant increase in carbon footprint and global warming hurting the earth, it can be seen that the conventional sources of energy that are in use today are not the best choice anymore. People understand the importance of preserving mother nature and economies are ready to transition towards advanced and cleaner energy alternatives. Ever since globalization, the growth of international trade and cross-border relations has played a crucial role in making this globe more connected through commodities and transactions. The urge to shift towards renewable energy options has provided nations across the planet the opportunity to harness this energy and develop their economy to become resilient towards the energy sector, making cross-border trade in such a scenario inevitable.

This paper aims to understand cross-border trading in this renewable energy sector. With the help of trend analysis and PESTLE analysis conducted on secondary data from various international organizations, the paper investigates providing a perspective on the socio-economic and environmental impact of renewable energy in developing countries and how this can be promoted and sustained in these economies. As the world progresses towards developing together by 2030 through achieving the 17 sustainable development goals of the United Nations, renewable energy and its upliftment in the arena of cross-border transactions play an important role in fulfilling this vision.

KEYWORDS:

Renewable energy, cross border, developing nations, trade, economy, green fuels

INTRODUCTION

The energy industry is one of the most essential industries, providing a significant contribution towards operations that help in economic growth. With the increasing pressure to find alternatives to coal and petroleum, this industry is taking up various measures to explore different renewable energy sources which would help create a positive impact on the earth while providing for the energy sources.

Being the lifeblood of modern economies in the twenty-first century, energy has determined the course of countries and the rate of global development. Access to energy is a complex thread that is woven into the fabric of global growth. Developing countries have struggled for decades to supply their rapidly growing populations with sustainable and reliable energy sources.

Accessing reasonably priced, dependable, and sustainable energy is a major problem for these countries. The cross-border trade of renewable energy comes into the picture here. By enabling the production of renewable energy, cross-border trade makes a significant impact by connecting nations across the world in the loop of demand and supply of these green fuels. Through the import-export cycles of sustainable energy, nations across the globe can make a change in pressing world issues such as global warming and providing sustainable job opportunities.

Renewable energy presents a chance to power economies sustainably and cost-effectively as the world's energy demands rise. In order to meet their energy needs and lessen the effects of global warming and carbon footprints, developing countries are increasingly viewing cross-border trade in

renewable energy as a vital strategy. This paper highlights how cross-border energy trade can accelerate progress toward developing nations.

REVIEW OF LITERATURE

Consumption of renewable energy across nations

Chen et al., 2020 examines the relationship between renewable energy consumption and economic growth might be either positive, negative or not significant. Having employed a threshold model using a 103-country sample in the 1995 to 2015 period, on the link between renewable energy consumption and economic growth the authors derived a result that if and only if developing or non-OECD nations cross a specific threshold of renewable energy consumption, the impact of renewable energy consumption on economic growth is positive and significant. However, the use of renewable energy has a negative impact on economic growth if it falls below a certain threshold in developing nations. Nevertheless, the result shows that the use of renewable energy has a favorable and large impact on economic growth in OECD countries, while it has little or no effect on economic growth in developed nations. Developing nations must use more renewable energy than a specific threshold in order to see positive economic growth from their investments in renewable energy.

ECOSOC- United Nations, 2023 In its press release emphasised the fact that in order to achieve the 2030 Agenda, 60 percent of the energy consumed has to be generated from renewable energy sources in the future. As of today, 80 percent of the energy consumption still depends on conventional sources of energy and a net zero world is not far from reach if we transition to alternative energy sources considering the advancements in technology. This transition towards green energy fuels will require governments to establish policies that embrace such change. The SDG goals 7 and 9 are interlinked (Clean energy alternatives and Industry, Innovation and Infrastructure) which makes governments of developing nations to invest in technology advancements that will in turn accelerate the global electrification process. Handing over this task to the private sector will definitely speed up the process but will not turn out to be beneficial for the general public. Governments need to step up in such cases and form public-private partnerships to boost the momentum of this change.

Cross border trade of renewable energy amongst nations

Jia et al., 2023 analyses the Belt Road Initiative and the changing trends in the trade of renewable energy due to the increasing emphasis on creating a positive effect on climate change. Since the year 2020 there has been a significant increase in the shift towards green energy sources making them account for around 41% of the total renewable energy consumption in the world. It can also be seen that this transition not only helps these countries to develop environmentally but also economically. Upon conducting correlation tests, the authors have found that the trade of renewable energy by the belt road countries has resulted in a weak positive correlation with economic growth and labour market and a negative correlation with foreign direct investment and trade hence proving that renewable energy transition in these countries has majorly impacted in improving economic growth and labour in these countries while trade and foreign direct investments prove to have no relation to the case.

Richards and Herman, 2010 in their publication address the complementary relationship between international trade and energy. It is important to note the range of products and services inclined to the energy sector that are traded across international borders. Initially the trade of energy between nations was not seen under the purview of the WTO and was something that was carried out outside the multilateral trade system. The GATs did not pay specific attention to trade carried out sector wise and were more or less providing a generic overview and regulation of trade. Though the technicalities involved in the energy sector clearly distinguish it from the regular trading done in other sectors of the economy, it can be observed that the trade in energy has somehow contributed towards the growth in trade and welfare of such nations. The accession of oil-producing countries might significantly alter the trade of this resource in the WTO.

Eghlimi et al, 2022 A decision-making model for organizing hybrid wind/solar power plants in the best possible way and trading electricity was presented to help optimize power generation and trade at the national level and measure the benefits of greater trade, the authors examined the economic, engineering, management, and policy challenges. Electricity trade is planned by taking hybrid wind and solar energy sources into account. Furthermore, by combining solar and wind power generating technologies, the efficiency of lowering the hourly power supply's variability is assessed. The power trade value and the quantity of installed solar and wind turbines are the primary determinants. By connecting the electrical networks of nearby nations, significant advantages can be obtained from the exchange of power. To determine the ideal degree of power trading across electrically linked nations, the scientists studied a regional electricity exchange model.

The **(United Nations Conference on Trade and Development, 2022)** report highlights cross-border trade as a key factor in measuring renewable energy production and consumption, particularly in developing countries. Many of these nations still rely heavily on fossil fuels and import energy from developed countries. It was noted that tariffs on brown energy are generally lower than those on green energy. While this doesn't indicate opposition to green energy, it may suggest these countries lack the capacity to adopt such technologies. Reducing tariffs on renewable energy trade is essential for encouraging the transition. The report also stresses the need for domestic policies that promote local green energy production and inland trade. By implementing trade policies that support renewable energy, these countries can reduce their reliance on conventional energy sources.

Socio-economic impact of renewable energy over nations

Virah-swamy et al., 2025 breakdowns that the rapid deployment of renewable energy systems to all parts of the world economy is a requirement to mitigate global warming in the assessment of social, economic and environmental factors. By evaluating three hundred and sixty-nine studies the authors analysed the numerous social, economic and environmental elements of the deployment of renewable energy technologies that have been investigated in the last ten years. In the context of societal factors, the authors discovered that younger people in many of the countries under study are more likely to pay for renewable energy. The deployment

of renewable energy was shown to be universally hampered by visual distractions and near proximity. In terms of economic considerations, a recurring concern was the quality of institutional governance since more and more research reveals that a lack of coordination, collaboration, and cooperation amongst different authorities is a systemic obstacle to the implementation of renewable energy.

In the aspects of environmental factors, the analysis emphasized that there is no one-size-fits-all method for evaluating the possible effects of renewable energy deployment on ecosystems, flora, and wildlife.

Bronstein, 2020 evaluates that energy is essential to economic progress. People frequently take it for granted, as do its stability, quality, and accessibility. Renewable energy (RE) has been hailed as the remedy for climate change and the technology that is invested in to balance the ever-increasing energy demands with the predicted effects on the climate. Renewable energy sources are expected to account for over 85% of the world's energy generation by 2050 (IRENA, 2018). According to Bloomberg New Energy Finance (BNEF), developing nations constructed more clean energy than fossil fuel-powered power plants for the second consecutive year. Yet a developing and perhaps hazardous waste issue is undermining this momentum. The author expresses that when renewables approach their end of life (EOL), they can be recycled, burned, disposed of in a landfill, or repurposed (by removing or refurbishing portions).

According to **(Simon Trace, 2022)** adopting contemporary renewable energy sources is essential for cutting emissions and reaching a low-carbon economy in countries with growing populations and energy demands. The economic potential of this strategy is demonstrated by studies on "green grids" and power trading in places like Southern Africa and South Asia. In light of global climate objectives, nations like South Africa, Bangladesh, and India that presently rely mostly on fossil fuels run the risk of being technologically locked in. When cross-border commerce is possible, coal is not competitive in the regions under study, with the possible exception of South Asia, where renewable prices do not decrease. Bidirectional commerce between India and the Gulf can improve energy security and reduce costs and emissions by taking advantage of various time zones and periods of peak demand. Regional transmission capacity expansion encourages access to renewable energy sources and lowers yearly CO2 emissions. Even if current technology is sufficient, electrical interconnector expenditure is required heading forward.

Investment in renewable energy

We Forum - Energy Transition, 2024 In this article titled 5 ways to boost renewable energy investment in developing economies. Thus, the author proposes five best practices for renewable energy investment, which contains regulated transparent power arrangements, specific clean energy/climate incentives, general business-friendly measures, innovative financing mechanisms and early risk assumption. Nevertheless, the government has the majority of the duty in these five areas. To reduce some of the risk and increase the likelihood of financial return on energy projects, governments in emerging economies must pass supporting laws. They ought to ask foreign financial institutions such as multilateral development banks to increase their funding capacity and risk instrument

offerings. In the meantime, developed-economy governments need to pledge to increase funding for climate financing and to offer more technical advising support.

IEA, 2024 in its world energy investment 2024 report, highlights that solar PV and wind projects offer strong investment opportunities, driving increased profitability for renewable energy firms. Compared to oil and gas companies, returns on invested capital for utility projects are rising. However, funding costs for renewables have slightly increased in recent years. Offshore wind projects faced challenges in 2023, including contract cancellations and cost increases, while the Chinese solar PV market struggled with price drops and overcapacity concerns. Despite these issues, wind turbine manufacturers have regained profitability, and the sector shows positive growth thanks to regulatory support and contract adjustments. Regulators are urged to remain responsive to market changes to foster renewable energy expansion.

Gupta, 2023 The IEA projects global renewable power capacity will grow by 2,400 GW over the next five years, with renewables accounting for 90% of electricity growth and overtaking coal as the main source of electricity by 2025. Developing nations hold immense potential for renewable energy adoption due to abundant resources and decentralized energy solutions, particularly in rural areas. Since 2015, these countries have outpaced developed ones in renewable energy investments, fueled by green financing and opportunities for job creation and economic growth. However, challenges like funding, infrastructure, grid integration, and technical capacity remain. Carbon credits can support both carbon neutrality goals and revenue generation. To accelerate renewable energy adoption, developing nations must prioritize financing, infrastructure upgrades, and technical expertise while fostering international cooperation. This shift promises expanded energy access, community benefits, and environmental sustainability.

RESEARCH METHODOLOGY

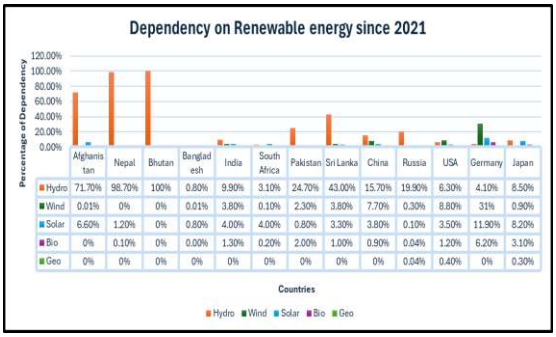
The research utilizes the secondary data approach. Data is collected from authentic government websites such as International Renewable Energy Agency (IRENA), United Nations Conference on Trade and Development (UNCTAD), International Energy Agency (IEA), and other literary works. With the help of trend analysis that is generated on the production of renewable energy and PESTLE analysis conducted, the paper aims to emphasize the significance of cross border trade to transition towards green energy. The data has been analysed with the help of MS Excel and is presented using bar charts, and column charts.

DATA ANALYSIS

Based on the data collected from our secondary sources, the following are the findings:

#1 Understanding trends in cross border trade in renewable energy across developing nations

Chart-1: Bar chart showing the consumption of renewable energy since 2021

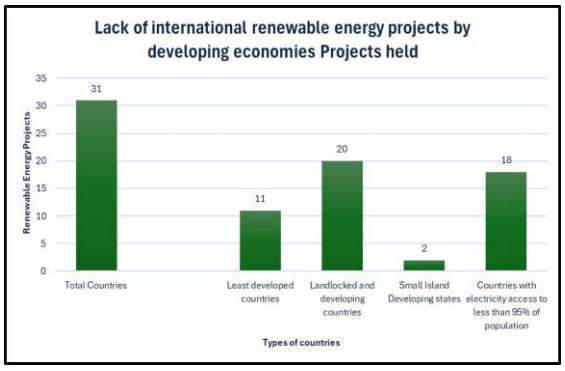


	Afghanistan	Nepal	Bhutan	Bangladesh	India	South Africa	Pakistan	Sri Lanka	China	Russia	USA	Germany	Japan
Hydro	71.70%	98.70%	100%	0.80%	9.90%	3.10%	24.70%	43.00%	15.70%	19.90%	6.30%	4.10%	8.50%
Wind	0.01%	0%	0%	0.01%	3.80%	0.10%	2.30%	3.80%	7.70%	0.30%	8.80%	31%	0.90%
Solar	6.60%	1.20%	0%	0.80%	4.00%	4.00%	0.80%	3.30%	3.80%	0.10%	3.50%	11.90%	8.20%
Bio	0%	0.10%	0%	0.00%	1.30%	0.20%	2.00%	1.00%	0.90%	0.04%	1.20%	6.20%	3.10%
Geo	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.04%	0.40%	0%	0.30%

(data from IRENA)

The above bar chart clearly charts out the consumption rates of different countries across 5 major renewable energy sources- solar, wind, hydro, bio and geothermal energy. It can be observed that many countries depend more on hydro energy compared to other energy sources considering the fact that it has lesser technology and infrastructure requirements with respect to its other alternatives. Many developing nations hardly show a bar depicting their lack of dependency on this kind of renewable energy. Geothermal and Bio energy seems to be very negligibly seen amongst all these countries considering the heavy investment that is required for the same.

Chart-2: Bar chart showing the lack of renewable energy projects in developing nations



(data from UNCTAD)

The above bar chart depicts the amount of renewable energy projects that are assigned to different tier of countries. It can be clearly seen that the number of least developed countries, land-locked developing countries and small island developing states seem to show very few renewable energy projects taken up under their wing. This shows that these countries either are not able to embrace the change towards such renewable energy courses or simply lack the infrastructure to adopt such advanced technology making them contribute less towards this global shift.

Table-1: Table showing relationship between renewable energy dependency and GDPpc of emerging Asian countries

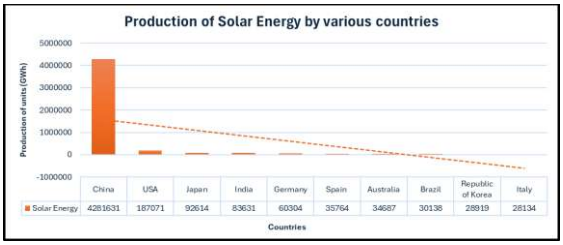
Table-3 Relationship between renewable energy dependency and GDPpc of emerging Asian countries

Particulars	China	India	Indonesia	Korea	Malaysia	Pakistan	Philippines	Thailand
REC%	22.9	45.44	44.88	1.1	6.57	49.58	35.21	23.29
GDPpc	2789	1003	2562	17855	7372	690	1894	4090
FD	0.401	0.294	0.297	0.724	0.809	0.256	0.3	0.503
GCF%	40.1	31.88	28.77	33.79	28.51	17.46	20.52	29.54

(Data from Heliyon Journal- research paper on "Does higher income lead to more renewable energy consumption? Evidence from emerging-Asian countries" by Ergun and Rivas)

Based on the above table it can be clearly seen that China, India, and Indonesia are dependent more on renewable energy sources compared to other countries. Their gross domestic product per capita can clearly show that there is no correlation between the per capita income of the country and its dependency on renewable energy sources. However, the dependency on renewables is a U-shaped slope with GDPpc and flow disruptions being factors that affect, hence countries by improving their economic status can help gradually improve their dependency on these renewable energy sources too in the future.

Chart-3: Column chart showing production of Solar energy by various countries

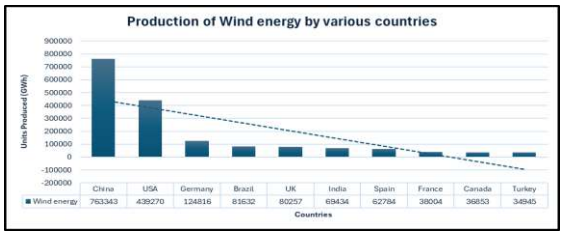


(data from IRENA)

The given column chart enumerates that in the production of solar energy by various countries, China is the leading producer in this field by dominating the production with producing 4281631 GWh units of solar energy. On the contrary Italy is the least

producer as it produces 28134 GWh units of solar energy. However following China, the USA, Japan and India take the next spots proving to be the significant contributors to the generation of solar energy as they keep growing their infrastructure and capacity.

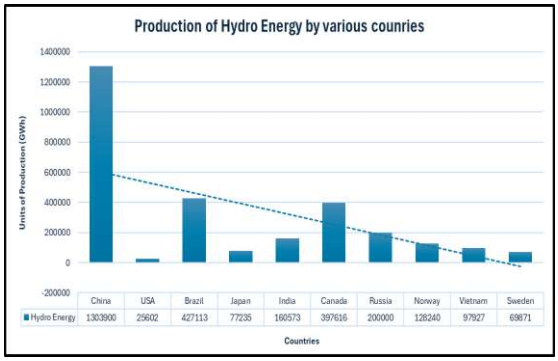
Chart-4: Column chart showing production of wind energy by various countries



(data from IRENA)

The shown column chart delineates the production of wind energy by various countries. As it is presented China leads in producing wind energy by 173% as it produces 763343 GWh whereas its competitor USA produces 439270. However, Germany produces slightly above 100000 Gwh meanwhile the other countries below 100000 GWh. The trend line shows a decreasing trend with higher production trend in China and least in Turkey.

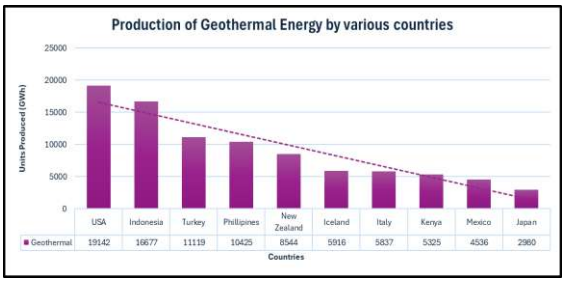
Chart-5: Column chart showing production of Hydro energy by various countries



(data from IRENA)

The presented column chart illustrates the production of hydro energy by various countries in which China predominates by producing more than 1300000 GWh. On the other hand, Brazil and Canada stand second and third subsequently by producing just around 400000 GWh. It is interesting to note that the USA is placed last with 25602 GWh units of production of hydro energy.

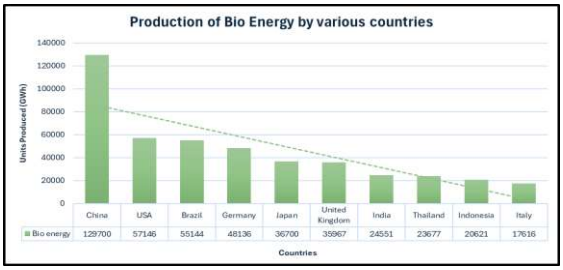
Chart-6: Column chart showing the production of Geothermal energy by various countries



(data from IRENA)

The shown column chart describes the production of geothermal energy by various countries. The USA and Indonesia dominate the chart by producing more than 15000 GWh units of geothermal energy. Whereas Turkey and Philippines produce slightly above 10000 GWh units. While New Zealand, Iceland, Italy and Kenya produce more than 5000. While Japan marks as the least production of geothermal energy with 2960 GWh units.

Chart-7: Column chart showing the production of Bio energy by various countries

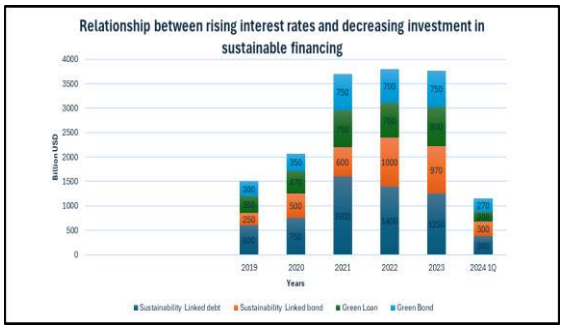


(data from IRENA)

The above column chart describes the production of bio energy by various countries. With China being the highest producer of Bio energy, Italy stands at the bottom by producing 17616 GWh units. Although the USA is placed second

followed by Brazil in third. In Contrast Germany, Japan, UK, India, Thailand and Indonesia produce bio energy below 50000 GWh units.

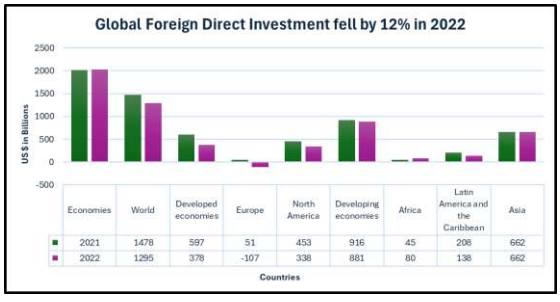
Chart-8: Stacked bar chart showing the relationship between rising interest rates and decreasing investment in sustainable financing



(data from IEA)

The presented stacked bar chart illustrates the relationship between the upsurge of the interest rate and the decreasing investment in sustainable financing. This chart clearly denotes that there is a gradual increase in the green bond from the year 2019-2022, followed by a mild fluctuation till 2023 and in 2024 it has a decreasing trend. Surprisingly the green loan is following the same trend. However, the sustainability bond and sustainability linked debt rises slowly in 2019 and achieve its peak at 2021 with 1600 billion USD and gradually decreases in the following years.

Chart-9: Bar chart showing the fall in foreign direct investment in renewable energy since 2022



(data from UNCTAD)

The above bar chart denotes the decline of global foreign investment in renewable energy in the year 2022 compared to 2021. Data calibration is done in dollars. A glance at the graph demonstrates that there is a reduction of 12% in the world in which the most affected region is Africa, as the investment has a decreasing trend to 44%. By Comparison, Latin America and the Caribbean had a substantial upsurge by 51%. Meanwhile Asia remained constant. It is also worth noticing that the developed countries took an overwhelming downfall of 37% while the developing economies had a tedious climb of 4%.

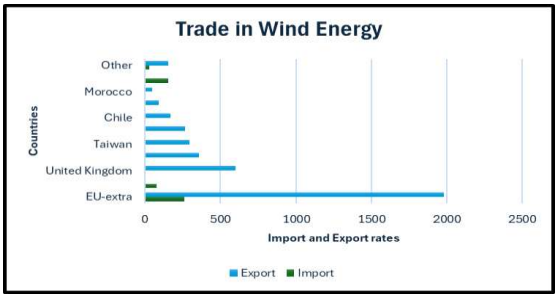
Table:2 Table depicting the trade of solar panels across countries

Table- 11 Trade related to Solar Energy (Units Traded)		
Countries	**Import**	**Export**
Extra EU	19,666	913
China	19,203	0
Switzerland	0	279
United Kingdom	0	232
United States	0	113
Ukraine	0	34
Norway	0	30
North Macedonia	0	26
Turkiye	0	22
Other	463	178

(data from EU)

The above table depicts the trade in solar energy across countries. The table clearly shows that there is a considerable amount of import in the European Union and China. In contrast the export rates of the EU, United Kingdom and the USA provide information that these countries export solar energy less than 1000. It can also be seen that Extra EU and Other countries contribute a significant share in the solar trade.

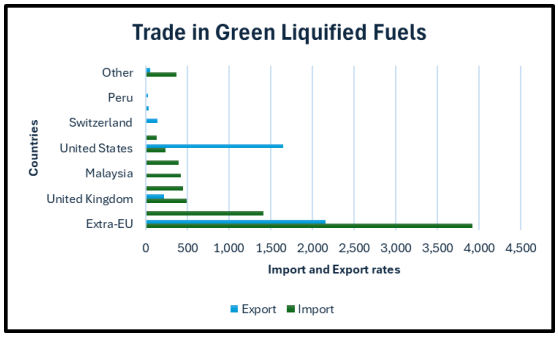
Chart-10: Columnar chart depicting the trade in wind turbines across countries



(data from EU)

The above columnar chart depicts the levels of import and export of wind turbines amongst various countries. It can be noted that the amount of export that is done to non-EU countries (Extra EU) is more than the levels of import that is done. It can also be observed that the export done to extra EU countries is around 2000 units compared to the other countries ranging from 0 to 500 units only. This shows that the demand for wind turbines apart from extra EU countries is said to be less in other countries, this can be due to the lack of adaptation to advanced technology or lack of land resources too to operate the same.

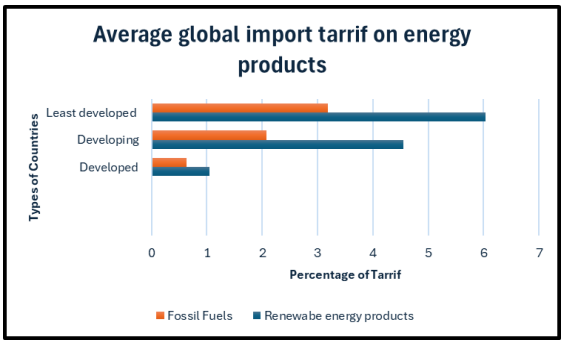
Chart-11: Columnar chart depicting the trade-in liquified fuels across countries



(data from EU)

The above columnar chart shows the trade flow of liquified green fuels such as bioenergy, geothermal energy and hydro energy across countries. It can be seen that the export margins of these fuels are comparatively more than the import margins. The amount of renewable energy imported from non-EU (extra EU) countries is comparatively larger than the import levels of renewable energy from other countries. Countries such as Malaysia are only found to be exporting renewable energy. The United States is importing around 1800 units compared to its export rate of less than 500 units. This chart provides an overall understanding that liquified fuels need to be developed more to improve their trade situation.

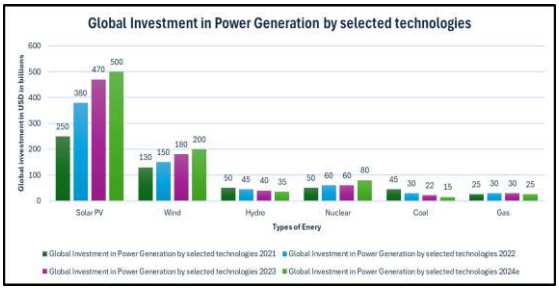
Chart-12: Bar chart showing the average global import tariffs on trade of renewable energy



(data from UNCTAD)

The above columnar chart depicts the amount of global tariffs that are placed on the import and export of renewable and fossil fuels by different types of countries. It can be observed that the chart shows an increase in tariffs towards renewable energy compared to fossil fuels, hence proving that all 3 tiers of countries depend more on fossil fuels than renewable energy sources. Challenges such as expensive initial adoption, storage and warehousing, waste management, etc. should be mitigated by countries to facilitate smooth transition to them. More than developed nations, developing and least developed nations have more tariffs placed towards green fuels hence proving the need to provide awareness about the same to these countries.

Chart-13: Bar chart showing the fall in investment of coal and power compared to solar panels



(data from UNCTAD)

The above bar chart depicts the growth in spending towards solar panels from 2021 to

2024. It can be observed that investment towards renewable energy sources such as solar panels, and wind turbines have substantially increased compared to nuclear, coal and gas power over the years. It shows how countries are taking up the responsibility to become green and are approaching fuel consumption in a sustainable fashion. If this increase in investment towards renewable energy continues, it can be forecasted that over the years the trade and value of these sources of energy will improve as well.

DISCUSSION

Based on the above data, we can clearly observe the following:

#2 Socio-Economic impact of cross border trade of Renewable Energy on Developing Nations.

Political

The data provides a comprehensive view on how nations across the world are trying to transition towards renewable energy alternatives. Countries like China, United States, United Kingdom, Germany, and Russia are already well ahead in terms of production and consumption of these green energy compared to developing nations such as South Africa, India, Bangladesh, Sri Lanka etc. India especially can be seen as a country that has substantially improved its production and consumption rates in solar and hydro energy by implementation of various government initiatives and schemes such as Grid Connected Rooftop Program, National Solar Mission, Schemes for Small Hydro Projects and many more. This shows that political stability in a country, especially developing nations, plays a huge impact on the adoption of renewable energy sources against its conventional counterparts.

Economical

From the graph related to trade of renewable energy sources, it can be viewed that the number of projects that are assigned to developing and least developed nations is very low compared to developed nations. The very idea of green energy sources being more expensive compared to the brown ones can be seen evidently through the higher number of tariffs placed for trade of renewable energy and those of non-renewable ones. Developing nations significantly depend on non-renewable energy sources more than renewable ones considering the low investment levels due to increasing interest rates on sustainable bonds. It can hence be deduced that a country's trade in renewable energy is significantly affected due to factors such as increasing price volatility, interest rates on sustainable foreign direct investment and trade tariffs placed. Indirect factors can be the overall world economic situation and man-made and natural disasters, and the per capita gross domestic product of the country.

Sociological

Based on per capita income and GDP affecting share on renewable energy, it can be clearly analysed that a country's social status plays a huge role in the dependency on renewable energy sources. Developing and least developed nations have always been subject to large poverty levels. Their schemes and government actions focus more on pressing issues such as No Poverty, Zero Hunger compared to non-critical issues. Countries like India, Indonesia, Malaysia, Pakistan and Thailand are showcasing significant dependency over renewable energy sources by improving their country's economic and

social status. Hence it can be said that a country's dependency on renewable energy, per capita income and GDP is a U-shaped relationship which affect each other Gradually over time.

Technological

A country's dependency on renewable energy is affected majorly by its technological capacity. The data retrieved from UNCTAD regarding the rise in investment in solar technology shows how many countries have understood the essence of transitioning towards green fuels. By investing in renewable energy tech, countries are not only realising the vision to become net-zero but at the same time are economically reaping benefits as the renewables market is slowly gaining momentum. It is essential that more developing nations understand the importance towards investing in such technology and improve the cross-border trade markets of renewable energy.

Legal

International organisations such as the United Nations place immense significance towards attaining sustainable development. With the emergence of Agenda 2030 and COP 29, nations around the world are striving towards achieving these goals. Shifting towards an eco-friendly fuel alternative in many countries has brought in many changes in the legal aspects towards the consumption of brown fuels. India can be clearly seen making efforts towards adopting greener fuel practices across different industries. Many countries face challenges with regards to consumption of renewable energy such as storage and waste management, and pricing. Hence it can be said that legal provisions play a significant role in the overall adoption of renewable energy.

Environmental

Renewable energy being the future of the energy industry has made a significant positive impact on the environment in countries where it has been fully adopted. Developed nations such as China, Japan, United States and United Kingdom have made humongous progress towards the usage of these fuels in their countries contributing to lessen carbon footprint. From the data provided with regards to trade and production of renewable energy, it can be seen that developing countries are still far from realising their goals and need to step up by lowering tariffs and boosting trade in renewable energy. Hence, we can say that the more a country is consuming renewable energy sources, the more that it is contributing towards the environment positively.

Based on the above PESTLE analysis, it can be summarized that developing nations must realise the need for renewable energy sources and must improve their involvement in trade regarding the same. The usage of a renewable energy source in abundance for economic activities by a country depends partly on the amount of renewable energy sources traded through cross-border trade and partly on how much it is able to produce.

Increasing international trade in renewable energy can help developing nations reduce their reliance on conventional energy, supporting Agenda 2030. However, price volatility affects this trade, and stabilizing it will boost renewable energy exchanges. Positive change is only possible with political and legal support, and through international reforms and domestic policies, developing nations can accelerate their transition to renewable energy.

CONCLUSION

As we revolutionise the energy industry with the transition towards renewable energy fuels, it is very much necessary that developing nations are not left behind in this momentum. With growing demands for green technology and green fuels amongst the consumers, it is essential that cross border trade in renewable energy boosts its growth pace. By indulging in cross border trade and foreign direct investment in renewable energy and technology, developing nations are slowly improving their status towards achieving net zero and are also benefiting tremendously in terms of social, economic and environmental development in their territories. With developed nations leading the front in cross border energy trade, it is the need of the hour to accelerate trade in renewable energy more than conventional sources even during times of distress.

The trend in renewable energy trade is growing at a gradual pace in developing countries and it needs to gear up to achieve the 2030 United Nations Agenda. This paper has aimed to understand the trends in cross-border renewable energy trade and has charted the impact of renewable energy trade in these developing nations by using Trend and PESTLE analysis.

#3 Promotion and sustenance of renewable energy trade by developing nations

The paper suggests the following as improving the trade scenario-

1) Raise awareness about renewable energy and encourage more businesses in this field by simplifying basic licensing and financing.
2) Stabilising pricing and reduction of interest rates on debt financing related to renewable energy in both domestic and international markets.
3) To incorporate sustainable financing and green bond investments in the financial market.
4) Facilitating the adoption of green technology and improving its scalability in domestic levels.
5) Provide for government schemes that aid the private sector to foster the change and address key challenges such as storage and waste management in this sector.
6) Support from developed nations and international organisations to help developing nations to incorporate renewable energy in their economic activities.
7) To introduce more policies and reforms to address the challenges faced in adoption of renewable energy.

The paper has future scope of research in analysing how the volume of trade in renewable energy can be correlated with the consumption of renewable energy of that country.

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DIGITAL SOVEREIGNTY: NATIONAL POLICIES ON TECHNOLOGY ACCESS AND TRADE

Rithu Varshini P, Yokeshwari K

ABSTRACT

This paper examines the intricate relationship between digital sovereignty and national governance in the contemporary technological landscape, investigating how countries navigate the complex challenges of data privacy, technological independence, and cybersecurity while balancing domestic interests with global interconnectivity. Through a comprehensive mixed-methods approach combining qualitative policy analysis, SWOT, PESTLE, innovation indices, and cybersecurity measurements, the research evaluates various national strategies for maintaining digital autonomy while fostering economic growth and international collaboration. By analyzing the diverse approaches taken by different nations and their resultant outcomes, the study illuminates the critical tension between preserving national sovereignty and maintaining essential cross-border digital interoperability, ultimately presenting evidence-based policy recommendations aimed at achieving a balanced and equitable digital ecosystem that serves both national interests and global technological progress.

KEYWORDS

Global interconnectivity, data privacy, SWOT, PESTLE, Digital sovereignty, National governance, Cybersecurity, Policy analysis, Digital autonomy.

INTRODUCTION

Digital sovereignty has become a vital issue in today's international relations, especially as countries navigate the complex interplay of technological progress, national security, and economic autonomy. The optimistic views of the post-Cold War era regarding unrestricted global technological collaboration have shifted to a more nuanced perspective on the strategic consequences of technological interdependence. This change has been driven by rising geopolitical tensions and the realization that technological leadership is closely linked to political and ideological rivalries among nations.

This evolution is particularly noticeable in Europe, where worries about technological reliance have broadened from specific areas like 5G infrastructure to include wider technological capabilities, such as artificial intelligence and e-mobility solutions. Unlike earlier phases of technological rivalry, like the "American Challenge" in the 1960s or Japan's dominance in microelectronics during the 1980s, the current environment poses fundamental challenges to the established rules-based international order. China's simultaneous pursuit of technological supremacy and systemic competition has led to a revaluation of traditional strategies for innovation policy and international technological collaboration.

This paper examines the concept of technology sovereignty through the lens of state-level agency within the international system, positioning it not as an end goal but as a crucial means for maintaining national competitiveness and enabling transformative policy capabilities. We argue that effective technology sovereignty requires striking a delicate balance between protecting strategic interests and maintaining beneficial international cooperation, avoiding both naive globalism and costly technological autarky. Through this analysis, we aim to contribute to the theoretical framework for understanding technology sovereignty business using

business analysis methodologies, such as SWOT, PESTLE.

REVIEW OF LITERATURE

Samuel Fratini et al., (2024) has examined on the emerging national digital sovereignty models and their effectiveness in response to changes and challenges. It analyzes 271 peer-reviewed articles to identify descriptive and value features, producing four models: rights-based, market-oriented, centralisation, and state-based. The study finds none fully combine comprehensive regulation of digital technologies with responsiveness to technological innovation and social and economic shifts, offering valuable lessons for policymakers.

Elizaveta Gromova (2024) et al., has studied on the BRICS+ expansion, attracting new countries, presents challenges and opportunities for the alliance, particularly in terms of digital sovereignty. The leading five BRICS nations can achieve digital sovereignty, while expanding to countries with varying levels raises issues for the alliance. This article proposes a theoretical legal model for BRICS+ digital sovereignty, using comparative, retrospective, and systematic methods to analyze regulations and promote cooperation. It analyses on BRICS+ digital sovereignty, concluding it's possible. They recommend collaboration, including developing a memorandum, launching a regulatory sandbox, and deploying a sovereign cloud.

Maximilian Mayer et al., (2024), has researched on digital international affairs that focuses on cybersecurity and the internet's role in nation-states' regulatory authority. The global digital economy and debates around technological sovereignty present new research challenges for IPE scholarship. The rise of digital sovereignty, particularly in China, indicates a drive for disruption to global governance and supply chains. The ongoing dynamics of fragmentation and problematization of digital dependencies are crucial. Experts warn of a "Cyber-Balkanization" or "Splinternet" due to increased national regulations and Sino-US competition over technologies.

Jürgen Janger (2024) has studied on EU that addresses geopolitical risks by reducing unilateral dependencies through trade, innovation, and industrial policy instruments. The policy brief focuses on fostering technological sovereignty to protect against risks from international trade in critical general-purpose technologies. The policy mix includes frontier, catch-up, and defensive policy mixes, focusing on improving framework conditions, supporting lagging technologies, and ensuring technological sovereignty.

Kholofelo Kugler et al., (2024) has studied on the implications for African Countries on navigation digital sovereignty that is Digital sovereignty refers to a country's control over its digital economy, influenced by regulatory frameworks, infrastructure, networks, technology, and data governance. The US, China, and EU have adopted various approaches, with African countries aiming to insulate themselves from external influence and cultivate a digital agenda to drive sphere. Initiatives like the Digital Trade Protocol provide opportunities for African countries.

Amaz Hassan et al., (2024) has explored on the navigating legal frontier on digital trade and data sovereignty in the contemporary Legal Landscape that is the paper explores the relationship between digital trade and data sovereignty in global commerce, highlighting the legal,

economic, and political implications. It examines the evolution of digital trade, data sovereignty, and legal frameworks, highlighting challenges and opportunities in technology, law, and policy. The paper also highlights the role of data in national security and international agreements in shaping digital trade and data sovereignty dynamics.

Philipp Staab et al., (2024) has studied on the technological sovereignty in Germany which shows that technological sovereignty is a growing concern for states, with states aiming to ensure security and economic competitiveness. Germany, a country with a deep-rooted adherence to ordo liberalism, is now formulating a strategic techno-industrial policy agenda to preserve sovereignty. This article analyzes the proposed agenda using an inductive process-tracing approach and document analysis of strategy papers, policy documents, and media reports. It argues that Germany's pursuit of technological sovereignty is a unique form of geo-economically motivated statecraft, focusing on commercial competitiveness rather than security. However, limitations exist due to the regulatory regime and institutional legacy at national and EU levels, which hinder strategic government interventions in the economy.

Sangeetha Mathure (2024) has explored on Digital sovereignty that shows nation's ability to regulate and manage its digital infrastructure, data, and information flow. It is crucial in today's digital world, as it involves balancing digital security, identity preservation, and global power. Balancing factors include protecting critical infrastructure, safeguarding sensitive data, implementing robust cybersecurity measures, establishing secure communication channels, and combating cyber threats. Cultural distinctiveness, local content promotion, and national values in data protection laws are also essential. Understanding global power dynamics is crucial, as is maintaining influence in the global digital economy. Promoting domestic digital industries and innovation is also essential. The article concludes by highlighting the complex task of finding balance in digital sovereignty and providing case studies of countries implementing measures.

Julia Rone (2024) has studied on the European Union has been promoting digital sovereignty in response to the digitalization of industry, disruptions in global supply chains, and the development of artificial intelligence models. The draft European Union Cloud Services Scheme (EUCS) was launched in December 2020, but its inclusion of digital sovereignty provisions has sparked controversies. Distributive conflicts between member states and diverging national preferences have led to strong objections. The paper argues that this is due to distributive conflicts between member states and horizontal inter-institutional conflicts around competences between the European Commission and the European Parliament. The study of EUCS provides a novel empirical contribution by bridging the growing literature on digital sovereignty with classic EU integration theories, identifying key factors hindering the translation of digital sovereignty discourses into policy within limited technological capabilities.

Svetlana Yakovleva (2021) has studied on the growing digital space has made cross-border trade in digital goods and services dependent on data regulation. While some borders exist in digital space, they may not align with state territorial jurisdictions, challenging sovereignty

claims in their traditional sense. These claims often detach from the sovereign itself and territory, leading to claims over functional allocation of power. The author thanks Elaine Fahey, Isabella Mancini, and participants of the series of workshops 'EU as a Good Global Actor' for their comments and engagement with the ideas expressed in this chapter. They also thank Daniel Gervais and peer reviewers for their insightful comments on the previous articles.

Martin Kaloudis (2022) has explored on European Union (EU) that is grappling with the impact of dependence on technologies from the USA and China on state sovereignty. Digital sovereignty aims to compensate for past deficits caused by insufficient software and hardware development. Autocratic states use digital autarky, while the USA promotes liberalization and openness. In the EU, regulation, data protection, and liberal values play a significant role in less pronounced IT development. However, there is no common understanding or definition of digital sovereignty, and there is a lack of a target and measurable index. This article proposes a definition for European digital sovereignty and the creation of an index, but the index needs further scientific refinement for applicability.

METHODOLOGY

The present conceptual manuscript endeavours to explore the domain of digital sovereignty on national policies and trade through business analysis methodologies, including SWOT and PESTLE analyses. The SWOT Analysis involves a comprehensive examination of the strengths, weaknesses, opportunities, and threats pertaining to the topic. The PESTLE Analysis is made to assess the political, economic, social, technological, legal, and environmental factors, examining the external factors affecting national policies and trade. The analysis is scrutinized through various literature reviews from top journals and special blogs contents across the world.

SWOT to comprehend digital sovereignty policies and trade

This swot analysis examines the strategic position of nations implementing digital sovereignty policies, particularly focusing on technology access and trade controls. This analysis considers internal capabilities (strength and weaknesses) and external factors (opportunities and threat) affecting policy implementation and outcomes.

TABLE 1
SWOT TO COMPREHEND DIGITAL SOVEREIGNTY POLICES AND TRADE

Strengths	Weaknesses
Policy control Enhanced cybersecurity oversight Job creation in local tech industries Reduced dependency on foreign technology	Technical expertise gaps Resource allocation Smaller market scale for domestic solutions Complex regulatory requirements
Threats	**Opportunity**
Rapid technological change Trade restriction and sanction Trade agreement complication Global market access limitation	Development of new technological standards Research and development investments Collaborative security frameworks Regional technology partnership

Strengths

The comprehensive internal strengths of the organization are anchored in two key domains: policy control and national security. In terms of policy control, the organization maintains autonomous decision-making authority over its digital infrastructure, allowing for agile responses to emerging technological challenges and opportunities. This autonomy extends to the

implementation of stringent data localization requirements, ensuring sensitive information remains within prescribed boundaries and jurisdictions. The organization also wields significant influence over critical technology standards, enabling it to shape and define technological frameworks that align with its strategic objectives. Complementing these policy strengths, the national security dimension demonstrates robust capabilities through enhanced cybersecurity oversight mechanisms that continuously monitor and protect against evolving digital threats. The organization has successfully established protected critical digital infrastructure, implementing multiple layers of security protocols and resilient systems that safeguard essential operations. A particularly noteworthy achievement is the strategic reduction of dependency on foreign technology providers, which has significantly minimized potential vulnerabilities and external control points. This decreased reliance on external technology sources has fostered greater operational independence and enhanced the organization's ability to maintain security protocols without compromising efficiency. Together, these internal positive factors create a robust foundation for sustainable technological sovereignty while ensuring the integrity and security of critical digital
assets and operations**.**

Weaknesses

The weaknesses associated with developing domestic alternatives are rooted in several internal limiting factors, including high development costs and significant technical expertise gaps. The implementation of these solutions also faces challenges such as complex regulatory requirements that make it difficult to navigate legal and policy landscapes. Market constraints make it even more challenging to grow, as lower access to global innovation means less ability to build on international progress, while a smaller market scale for domestic solutions makes it tougher to achieve economies of scale. This leads to costlier options for consumers and businesses alike, which therefore makes these alternatives less competitive. The infrastructure requirements in switching to domestic solutions are also very high. Required investments can be high; firms would need to invest huge resources in modernizing the system and in building new infrastructure. Adding to this complexity, legacy systems also carry a load of technical debt which calls for careful management in integration with new technologies. Complications in resource allocation create another problem because firms are forced to balance their desire for new investments against existing operations' ongoing demands. These internal, market, and infrastructure challenges make the development and implementation of domestic alternatives so complex and resource-intensive.

Opportunity

Growing global emphasis on digital autonomy provides enormous opportunities for strategic development. Nations are growing to secure their technological independence. This shift creates open opportunities for regional technology partnership opportunities that foster the building of sovereign digital solutions adapted to local needs and develop these markets, now fast gaining ground, due to government and organization aspirations to reduce reliance on foreign technologies. In addition, there is significant innovation potential, as new technological standards are developed to ensure security, privacy, and control within digital infrastructures.

Alternative technology ecosystems create opportunities for countries to diversify their digital capabilities and reduce risks associated with monopolistic foreign dependencies. Research and development investments will be crucial in advancing these innovations. On the international level, the digital sovereignty alliances between nations make the new ecosystems stronger and more resilient. Knowledge sharing among partner nations will allow the sharing of best practices, thus growing and accelerating technological progress. Collaborative security frameworks will provide a unified approach to emerging cyber threats, so that nations can safeguard their digital infrastructure while maintaining control over their technological futures. These possibilities signify an increasing global trend towards digital self-sufficiency and innovation.

Threats

It encounters different types of external challenging factors. Global competition is at the top of this list. A great danger for the company comes in the form of technological gap development, especially in the core domains of artificial intelligence and automation. Economic pressure from dominating countries that are often technology leaders further complicates the issue. Trade restrictions or sanctions can also interfere with the supply of vital resources or prevent market expansion altogether. On the technical front, rapid technological change creates an environment where constant adaptation is required. Interoperability issues are a significant obstacle to keeping ahead of the company since its products may fail to fit into existing systems and technologies. Cybersecurity vulnerabilities are another constant threat that may jeopardize data security and trust among users. International relations also possess risks to the stability of the company. Diplomatic tensions between countries can affect operations, especially those in areas with high stakes for geopolitical interests. Complicated trade agreements and barriers to access may limit expansion opportunities in the market, which is the main limitation of this company to reach global customers and suppliers. All these external threats together form an environment where careful navigation of technological, economic, and political factors is crucial to maintain a competitive edge and ensure long-term success.

PESTLE Analysis on digital sovereignty on national policies and trade

A PESTEL analysis examines the macro-environmental factors that can influence a business or industry. For digital sovereignty on national policies and trade, this analysis can help understand the external factors affecting its adoption and implementation. Here's a breakdown of each factor:

TABLE 2
PESTEL ANALYSIS OF DIGITAL SOVEREIGNTY POLICES AND TRADE

Political	Economical	Sociocultural
National interests Geopolitical tensions Regulatory policies	Tech investments Digital economies Trade barriers	Cultural preservation Trust in technology Access to technology
Technological	**Legal**	**Environmental**
Tech alliances Innovation and R&D Cyber security	Data protection Intellectual property Trade agreements	Climate change E–waste management

Political

The rising US-China geopolitical rivalry has been causing a debate over foreign technology companies ruling domestic affairs and possible interference via digital

means. Countries have been implementing policies to protect their infrastructures and promote their native technology industries. The strain between national security and individual rights also forms a significant issue. The protection of citizens against cyber threats and the respect for such rights as privacy and freedom of expression make governments debate between them about government surveillance and using digital technologies for social control. Therefore, the political aspect of digital sovereignty is highly diversified because it depends on geopolitical competition, national security, personal rights, and the speed at which digital technologies are advancing. This means governments must go through these complexities to successfully advocate for digital sovereignty in relation to democratic values and the economy**.**

Economical

Digital sovereignty policies are expected to boost domestic innovations, investments, and employment while promoting a data economy: excess protectionism would constrict competition and foment barriers to market entry for many actors, creating potential fibrillation in the worldwide digital services ecosystem. Cybersecurity risks are present in different forms, representing significant economic threats. Policymakers are called upon to strike a seamless balance between economic growth and national security, redressing the imbalance of the digital divide, stimulating global cooperation, and misaligning changes with technological disruptions risking the sustainability and lack of inclusivity in the digital economy.

Sociocultural

Digital sovereignty policies can have both beneficial and adverse ramifications for society. They may empower citizens to protect their data privacy, promote confidence in digital services, and widen access to the digital sphere. This can create a well-informed, engaged citizenry that gives a chance for access to information and services by marginalized communities. Policies for local data storage and digital literacy can bridge the digital divide and empower individuals. Conversely, overly invasive surveillance policies may hinder access to global online platforms and services and lead to extensive surveillance and censorship. Therefore, it is important for policymakers to balance these conflicting social considerations accordingly. Digital sovereignty policies need to protect the rights and interests of citizens and push for innovation, economic accessibility, and national security. This requires a moderate approach to policy-making that accommodates the different requirements of all stakeholders: citizens, businesses and governments.

Technological

Digital sovereignty policies are essential for the promotion of technological innovation through domestic R&D, introduction of new emerging technologies, and generation of new opportunities. Effective collaboration and innovation can be nurtured through development and support for national cybersecurity capabilities and promotion of FOSS and open data. Strictly prohibitive or protectionist policies will limit progress. An increased requirement for localization of data may constrain the ability of businesses to exercise cloud computing and other emerging technologies that depend on global data flows. Preference towards domestic technologies over foreign ones may stifle competition and innovation and restrict dynamism and competitiveness within the technology sector. Sound balancing of these opposing considerations is set to

allow policymakers to tailor digital sovereignty policies that engender technological innovation and at demand national interests and values. This invites a more nuanced approach to a rapidly changing tech landscape, considering how various impacts, both pros and cons, might affect society.

Legal

Policies governing digital sovereignty are instrumental in developing legal frameworks and principles on cybersecurity, data protection, and online interactions. Given the rapid development of digital technologies and therefore their far-reaching impacts, these instruments may generate legal ambiguities and other complications. While the global nature of the digital economy could induce conflicts between national legal regimes and international conventions, the rapid development of digital technologies may bring in areas where the law is unclear and inconsistent enforcement. Policymakers should strive to achieve equilibrium concerning these legal issues in order to ensure that digital sovereignty rules are crafted based on lawful, suitably transparent, and uniform frameworks that respect individual rights, foster innovation, and guarantee fair competition for enterprises. This requires open dialogue and ongoing cooperation among legislators, legal practitioners, and stakeholders.

Environmental

digital sovereignty policies achieve mixed effects in terms of environmental impact, both positive and negative. On the positive side, this is an opportunity for implementing sustainable technologies in data centers, through renewable energy sources, as well as energy-efficient appliances. Such the use of renewable sources of energy in data-centers, energy-efficient appliances, and other sustainable technologies will bring about several advancements. Data centers that underpin the digital economy consume vast amounts of energy, a source of greenhouse gas emissions. Fast obsolescence can generate high levels of electronic waste, which can, unless properly disposed of, create severe threats to the environment. Politicians have to position themselves against such contradictions, such that implementation of digital sovereignty policies further advancement to environmental sustainability, while also working towards enabling expansion within the digital economy

CONCLUSION

The interplay of sovereignty in the digital realm as well as national policies in trade is a dynamic multi-faceted challenge in a contemporary technological landscape. Overall, the findings of the research show that the finding of a balance between nationalism and global interconnectivity proves to be a complexly attainable goal. The SWOT analysis highlights the critical strengths nations possess, such as policy control, cybersecurity oversight, and the potential for local tech industry growth, while acknowledging weaknesses like resource allocation, technical expertise gaps, and regulatory complexities. However, from regional technology partnerships, research and development investments, innovative standards, and many others, threats are major on global competition, trade restriction, and technological change that make vigilance and adaptability very essential.

Further information on external factors of policies on digital sovereignty through a PESTLE analysis can include political factors such as the national interest and geopolitical conflict entwined with

economic aspects on issues about barriers to trade and investments on technological changes. Socio-cultural considerations stress the importance of preserving cultural identity and fair access to technology, whereas the technological perspective emphasizes cybersecurity, innovation, and alliances of technologies. The legal considerations related to data protection, intellectual property, and trade policies remain vital, just as the environmental factors, including climate change and proper e-waste management.

This research underscores the fact that adopting a strategic approach toward digital sovereignty should incorporate business analysis methodologies within the frameworks of robust policies. In order for countries to achieve resilient digital ecosystems, innovation must be fostered and research and international collaborations must be invested in. Countries can go ahead to navigate the complexities of digital sovereignty with economic growth and security if they adopt strengths, overcome weaknesses, seize opportunities, and neutralize threats. These findings provide actionable insights and evidence-based policy recommendations to guide policymakers and stakeholders in their efforts to craft strategies that safeguard national interests and promote global technological progress.

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ARTIFICIAL INTELLIGENCE IN TRADE: TRANSFORMING LOGISTICS AND SUPPLY CHAIN

Ramya K, Reyaasvee S

ABSTRACT

This study investigates the revolutionary influence of artificial intelligence in trade and logistics using comprehensive business analytic methods, providing a thorough grasp of its application, problems, and future prospects. The paper investigates the complex link between AI technology and supply chain operations, providing useful insights using PESTEL and SWOT assessments. The study has practical consequences for three key stakeholders: corporate organizations, technology suppliers, and industry policymakers. The analysis finds considerable operational advantages, with firms reducing stock management inefficiencies by up to 45% and improving supply chain visibility through AI integration. The report makes strategic recommendations to organizations, encouraging them to invest in predictive analytics, automated decision-making, workforce development, and the integration of emerging technologies such as IoT and blockchain. Industry officials are recommended to create balanced frameworks that encourage innovation while also addressing cybersecurity concerns, data privacy, and worker adaption. Economic feasibility, technological infrastructure, environmental sustainability, and social impact are all stressed, with a call for collaborative efforts to develop a harmonized AI ecosystem. Finally, this complete research assists stakeholders in understanding and managing the challenges of AI adoption in trade and logistics, promoting an atmosphere that promotes long-term digital transformation and operational excellence.

KEYWORDS:

Artificial Intelligence, Trade Logistics, Supply Chain Management, Digital Transformation, PESTEL Analysis, SWOT Analysis, Predictive Analytics, Blockchain Technology,

INTRODUCTION

The fundamental changes brought about by the rise of AI in trade and logistics are the basic elements in the way businesses undertake cross border trade. With the increase in AI capacity – from forecast systems to self-operating systems – companies are able to remove operational constraints, improve strategic objectives, and meet environmental targets with precision never experienced before. AI enables companies to strategically control and manage trade elements leading to stability and growth in the rapidly changing dynamics of today's world marketplace.

This paper seeks to understand the role of AI in the changing dimensions of trade and logistics especially the actual proof of concepts, the challenges towards implementation, and the opportunities knocking. Through systematic assessment of extant literature and cases, we identify the central drivers of innovation in this area, such as ML algorithms, blockchain, and IoT architecture. It is critical to bring forth AI solutions in a manner that combines economic gain with social benefit and environmental sustainability towards three pillars integrated approach.

This paper adds to the discussion on the linkage between artificial intelligence and the contemporary supply chain dynamics with possible implications to various actors in the worlds – government regulators, business leaders, tech innovators, and so on. Our study underscores the great importance of having strategic AI funding, hiring training programs and strong policies in place to allow the system to grow.

REVIEW OF LITERATURE

Dash et al.,2019 conducted research on the ways in which artificial intelligence is transforming business operations in the retail and manufacturing sectors, the study comprises of supply chain management, AI, robotics, cloud-based machine-learning, information processing algorithms. The author concludes that adoption of artificial intelligence is becoming a worldwide industrial priority, since businesses must rethink their operations and strategy to completely leverage AI.

Richey jr et al.,2023 evaluated the trans-formative potential of AI in logistics and supply chain management by analyzing applications, addressing implementation challenges, and establishing a research framework for future industry integration. The key variables are automated decision-making, supervised machine learning, cyber resilience machine and deep learning. The author suggests that in today's digital era, the Journal of Business Logistics (JBL) continues to prioritize technology-oriented research, particularly in emerging areas like Block- chain.

Al-khatib et al.,2024 investigates the impact of generative AI capabilities on the performance of digital supply chains in Jordan's manufacturing firms through ambidexterity innovation. It employs hybrid analysis to address research gaps. the key findings are exploitative innovation (EXTI), exploratory innovation (EXPI), Digital Supply Chain Performance (DSCP), Generative AI Capabilities (GAIC). Research shows that generative artificial intelligence improves the effectiveness of digital supply chains in Jordanian manufacturing organizations, thereby advising businesses to make investments in AI technologies and give both exploratory and exploitative innovation top priority.

Idrissi et al.,2024 conducts a comprehensive review of the academic literature regarding the integration of AI, IoT, and Blockchain technologies into Smart Logistics in order to enhance supply chain operations. the key variables are Blockchain, AI, IoT, Big Data, Smart transportation, Smart logistics. The author concludes that blockchain, IoT, and AI are still in the early stages of smart logistics but have immense potential. Researchers and practitioners should work together to turn conceptual findings into practical applications.

Gupta et al.,2023 conducted research using quantitative surveys and expert interviews to examine the effects of blockchain and artificial intelligence on supply chain financial resilience, with an emphasis on environmental dynamism as a moderator. The key findings are Artificial Intelligence (AI), Block-chain Technology (BT), Supply Chain, Financial Resilience, Environmental Dynamism. The study suggests that block-chain technology has a greater influence on supply chain financial resilience than AI, with AI excelling at environmental sensing and block-chain at capitalizing on business possibilities.

Khimanych (2024) explored the application of Artificial Intelligence (AI) in Supply Chain Management (SCM), highlighting its benefits in automation, cost reduction, and efficiency. Challenges include data quality, integration issues, and organizational resistance. Recommendations involve strategic planning, skilled workforce development, and ethical AI use.

Nowacki and Wierdzbic (2024) investigated AI implementation in transport logistics planning for retailers. The study comprises variables such as container filling (TF), production plans (P), and warehouse

distribution (WP). The key finding revealed AI reduced stock backlog by 45% and increased trailer filling by 9.2%. The authors also suggested further research testing AI models in various logistics contexts and examining long-term impacts.

Ma and Chang (2024) examined how big data analytics and artificial intelligence enable digital supply chain transformation in automotive industry. The study comprises variables such as BDA-AI, supply chain internal/external integration, and supply chain agility. The key finding revealed all variables positively influence digital supply chain transformation. The authors also suggested the study expands organizational information processing theory in digital transformation context.

Liu et al. (2022) analyzed AI-based risk models for financial services in energy supply chains, improving credit accuracy and risk forecasting. The key variables are Operational Risk, AI, Regulatory Risk, Risk Forecasting, Credit Accuracy, supply chain. They recommended enhanced credit systems and market research for effective risk mitigation.

Zrelli and Rejeb (2024) explored IoT's impact on SCM, emphasizing efficiency, sustainability, and security. They highlighted trends like block-chain and AI integration and suggested empirical studies and regulatory solutions to enhance IoT adoption.

METHODOLOGY

The current study employs a variety of business analytical approaches, including PESTEL and SWOT assessments, to investigate the impact of artificial intelligence in commerce and logistics. The SWOT Analysis is a thorough analysis of the strengths, weaknesses, opportunities, and threats related to AI adoption in the business setting. The PESTEL Analysis attempts to examine the political, economic, social, technological, legal, and environmental variables driving both AI adoption and the enterprises that use these technologies. The analysis is conducted utilizing multiple literature reviews from leading journals and research papers published between 2019 and 2024, with an emphasis on artificial intelligence, supply chain management, robots, cloud-based machine learning, and information processing algorithms. The study combines findings from several fields to provide a comprehensive knowledge of how AI transforms operations.

RESULTS AND DISCUSSION

PESTEL ANALYSIS

Political

Government rules and international policies dominate the political landscape of artificial intelligence in trade and logistics. Nations are increasingly establishing comprehensive AI plans that will impact supply chain development and cross-border activities. Trade agreements are being amended to include AI and automation requirements, and data sovereignty regulations govern how AI systems can operate across borders. Governments are also enacting rules to promote fair competition between traditional and AI-enhanced logistics firms. Political disputes between large economies influence the adoption of AI technologies, particularly in sensitive sectors such as ports and customs processes, resulting in varied levels of deployment across regions.

Economic

The economic impact of AI in trade and logistics is a transformative possibility for the industry. Initial adoption necessitates a significant investment in infrastructure, technology, and training, but it often results in 20-30% cost reductions through

increased efficiency. Organizations are saving money on operating expenditures because to automated warehousing, better routing, and predictive maintenance. The work market is changing, as conventional occupations are automated and new positions in AI management and maintenance arise. Supply chain predictability has increased, lowering inventory expenditures and stockouts. Companies investing in AI-driven logistics get a competitive advantage through shorter delivery times, fewer errors, and better resource allocation, resulting in higher profit margins.

Social

The social consequences of AI in trade and logistics are centered on worker change and societal adaptability. Workers throughout the supply chain sector are seeing major changes in their roles, necessitating upskilling and adaptability to new technologies. Consumer expectations are changing, with speedier deliveries and real-time tracking becoming the norm. Concerns about data collection and use in AI-powered systems are increasing. Cultural factors influence AI adoption rates in different regions, with differing degrees of acceptance and resistance. The impact on employment is significant, causing employee worry while also bringing up new career prospects in AI-related industries.

Technological

The technological underpinning of artificial intelligence in trade and logistics includes a variety of new ideas. Demand forecasting and inventory optimization are powered by machine learning algorithms, while autonomous trucks and robotics are transforming warehouse operations. IoT sensors provide for real-time data tracking and monitoring across the supply chain. AI systems have large data processing requirements, which are supported by cloud computing infrastructure. The integration of blockchain technology and artificial intelligence ensures that transactions are transparent and secure. Advanced analytics technologies enable predictive maintenance and route optimization. These technologies are always changing, with new capabilities emerging for more efficient and automated supply chain operations.

Environmental

Environmental concerns have become crucial to AI implementation in trade and logistics. Smart routing algorithms optimize delivery routes and vehicle use to reduce fuel consumption and carbon emissions. Predictive maintenance enabled by AI can assist prevent equipment breakdowns that could result in environmental issues. AI-powered waste reduction and resource optimization improve sustainable supply chain processes. Environmental compliance monitoring is automated to ensure regulations are followed. AI supports green logistics projects by increasing capacity utilization and decreasing empty kilometers. The system allows for real- time environmental effect assessment and operating adjustments to ensure sustainability.

Legal

legal framework for AI in trade and logistics tackles a number of crucial issues. Regulations emphasize AI liability in automated decision-making processes, particularly for self-driving cars and automated warehouses. Data protection standards such as GDPR have an impact on how AI systems acquire and process information across borders. Intellectual property rights for artificial intelligence systems must be carefully considered in international trade. Compliance with

automated customs systems and international norms is necessary. Legal frameworks are constantly changing to handle new obstacles in AI deployment, such as privacy concerns, security needs, and liability issues in autonomous operations.

SWOT ANALYSIS

Strengths

AI Streamlining logistics processes is made easier by AIs as it cuts down on manual work and mistakes as well as enhances efficiency. It gives out shipment monitoring which helps in knowing the exact position of a shipment thus easing decision making processes. Moreover, such operational and routing efficiency generates valuable savings for the company and since AI has no boundaries businesses are able to expand in any direction due to fluctuating demands.

Weaknesses

To be able to use AI technologies one has to incur a lot of expenses which makes them limited for small scale businesses, moreover several startups also try to ignore such technology. In addition, many companies do not have a sufficient number of qualified workers who could manage these systems. An additional problem posed by AI is the need for its effective operation to have accurate and properly structured data sets, such a need may be problematic if the data is absent. Furthermore, there still is resistance of employees whose work is related to traditional supply chains, as they fear losing their jobs due to taking on new technology.

Opportunities

The cut throat competition among e-businesses has necessitated logistics further establishing the role of AI. By enhancing the efficiency of fuel usage, AI also further promotes environmentally friendly supply chains as it lowers emissions. In international business, AI helps to speed up customs clearance and increasing its performance efficiency. The ongoing improvements to such technologies as robotics and machine learning will fuel further opportunities for innovations.

Threats

Lack of internationally harmonious AI regulations makes issues of global application difficult. Cyber security problems including hacking and data loss are also issues which affect AI systems.AI-enabled robotics in industry is unwanted due to fear of unemployment, while investments in AI may be restrained due to the economic recession.

This analysis illustrates the disruptive nature and the issues of AI in the processes of logistics and supply chains.

CONCLUSION

The integration of artificial intelligence in trade and logistics represents a remarkable evolution in how businesses manage their supply chains. Our analysis of recent research, particularly studies from 2022-2024, demonstrates that AI is not just a technological tool, but a strategic imperative that is reshaping the industry. As evidenced by Nowacki and Wierdzbic's (2024) findings of 45% reduction in stock backlog and 9.2% improvement in trailer filling, AI's impact on operational efficiency is substantial and measurable.

The PESTEL analysis reveals a complex landscape where government policies, economic considerations, and technological capabilities intersect. While initial AI implementation requires significant investment, the resulting 20-30% cost reductions through improved efficiency make it a compelling business case. The social dimension cannot be overlooked, as organizations must balance technological advancement with workforce

adaptation and training.

Our SWOT analysis highlights that while AI excels in reducing manual errors and enabling real-time monitoring, challenges persist in terms of implementation costs and data quality requirements. However, as demonstrated by Al-khatib et al. (2024) and Ma and Chang (2024), organizations that successfully integrate AI with other digital technologies like IoT and blockchain are seeing tangible improvements in their digital supply chain performance.

Looking ahead, the path to successful AI integration in trade and logistics requires a balanced approach. Organizations must invest in both technology and people, ensuring that AI implementation aligns with business objectives while addressing practical challenges of data security and workforce development. The future of trade and logistics lies not just in the technology itself, but in our ability to harness it effectively while maintaining the human element that drives innovation and adaptation in our rapidly evolving global supply chains.

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