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Revolutionising Last-Mile Delivery: A Systematic Review on Dark Stores in Quick Commerce

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ABSTRACT

Purpose: The consumer needs are rapidly changing and shifting more towards online purchasing primarily for convenience, along with price consciousness and short delivery time. To meet these consumer needs, there are many platforms developed in recent years, and the most recent advancement that has happened in online e-commerce is the launch of Quick Commerce. The concept behind this quick commerce is to meet the needs of consumers rapidly, which led to the emergence and launch of dark stores, which are known as micro fulfilmentcentres. By systematically reviewing the existing literature over the years, this study helps to establish the relationship between e-commerce and the emergence and growth of dark stores, which are a part of quick commerce.

Design/Methodology/Approach: A systematic literature review (SLR) was conducted using peer-reviewed articles published between 2021 to 2025, and also analysed articles with the most citations related to dark stores and quick commerce. A compiled RIS data set was analysed using VOS viewer for Bibliographic coupling of keywords, Quick Commerce and Dark Stores, and keyword frequency analysis.

Findings: The analysis identifies "quickcommerce" as a central the matic node linked to three primary clusters: (1) operational efficiency (e.g., logistics, automation, last-mile delivery); (2) consumer behavior (e.g., convenience, customer satisfaction, pricing); and (3) economic considerations (e.g., cash burn, omni channel retail).

Research Limitations: There view is limited to the English language and also region-specific data bases from indexed academic research sources.

Managerial Implications: Findings will create insights for supply chain managers, marketing analytics of Q-Commerce platforms, and urban planners seeking to optimize delivery networks using dark store infrastructure.

Originality/Value: This is one of the first systematic reviews to compile existing literature on dark stores in Q-Commerce, which is offering a structured conceptual foundation for future research.

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Introduction

Quick commerce (Q-Commerce) is an advanced evolution of E-Commerce, which leads to a change in retail by focusing more on rapid delivery, and it' soften within a few minutes for reaching the target consumer and meets their expectations with respect to time and money constraints. Initially, online food delivery services were popularised by many online platforms on the basis of fast delivery; now it's Q-Commerce, which acts as a major revenue generator across essential categories such as groceries and personal care products, allowing digital retailers to compete with traditional e-commerce giants like Amazon (Stojanov, 2022). The model has evolved through innovations in last-mile logistics by a deep understanding of modern consumer behavior, where time and convenience are key decision-making motives.

This shift was majorly influenced by the COVID-19 pandemic, which acted as a catalyst for increased adoption of e-grocery platforms known as Quick Commerce platforms, which ensured safe, contactless delivery of essentials to end consumers. (Ganapathy & Gupta, 2023). In 2020 alone, the e-commerce logistics market grew by around 27%, exposing inefficiencies in traditional delivery systems and intensifying the main focus on maximising last-mile delivery. The last mile delivery refers to the climax of the final stage of reaching from the warehouse to the end consumers. In the case of a quick commerce platform, they try to reduce the distance from the warehouse or the micro fulfilment centres, which are also known as dark stores, to the destination of the end consumers (Andreas, 2024).

At the base of Q-commerce lies the concept of dark stores, which are the small, strategically located micro-fulfilment centres within urban or semi-urban areas that are closed to the public but serve as dedicated hubs for fast order processing. These facilities play a major role in improving logistics innovation, reducing delivery time and cost through automation technologies such as robotics, conveyor systems, and real-time inventory management (Gund & Daniel, 2024; David et al., 2024). The dark store model is especially prominent in countries like India, where the purchasing power of the middle class is rapidly growing due to the widespread use of smart phones, and rising internet penetration has contributed to Q-commerce expansion. Companies like Zepto and Swiggy Instamart have a greater contribution to the growth of micro-fulfillment centres for strategies to deliver products within 10 minutes, and these reshape the urban logistics framework in cities like Bengaluru, Chennai, and New Delhi (Ranjekar & Roy, 2023).

Furthermore, the intersection of Q-commerce and consumer behavior has become increasingly important. Research indicates that the efficiency and accuracy of last-mile delivery significantly influence consumer satisfaction and online shopping patterns more than demographic factors (Chavhan & Dutta, 2025). Consumers now expect reliability and timeliness, pushing businesses to invest in automation and predictive analytics to fulfill those expectations (Klein & Popp, 2022).

However, the sector does also face a number of challenges with the increasing competition and operational difficulties. One of the major challenges faced by the sector is the high operational costs, which are often termed "cashburn" and are associated with managing dark stores, inventory systems, and also related to last-mile delivery; these can threaten the long-term survival of the organisation. Startups like Noyes were the first to come up with solutions such as nano ware houses and automated picking system store duce expenses, which were another major contribution to dark stores (Ganapathy & Gupta, 2023). In contrast, the famous Q-Commerce platform, Dunzo Daily's financial losses and subsequent withdrawal from dark store operations lead to the finding that there is a huge importance is required for balancing service speed with profitability. As the Quick Commerce market is projected to grow to $70 billion within three years, it's essential to maintain a balance between operational efficiency and customer loyalty, which will be a major contribution to Quick Commerce development. Q-commerce must not only meet urgent demands but also build long-term relationships between consumers through reliability and convenience. In this context, dark stores and innovations in logistics will Continue to play a transformative role in revolutionizing last-mile delivery in urban retail environments (Ranjekar & Roy, 2023).

Objective

To systematically explore and synthesize existing literature to understand how dark stores are transforming last-mile delivery in Quick

Commerce by examining their operational role, consumer-centric implications, and economic sustainability.

Systematic Literature Review

This study employs the Systematic Literature Review (SLR) methodology as outlined by (Tranfield et al., 2003), a frame work initially developed for evidence-based practices inmedicine and later adapted for management and other business disciplines. The SLR process is structured into three main stages: Planning, Conducting, and Reporting, providing a careful and transparent basis for compiling existing research on dark stores in the context of quick commerce (Q-commerce).

Planning

The planning stage began with the identification of research gaps related to last-mile delivery and micro-fulfillment centres or dark stores within Q-commerce, as discussed in the Introduction. The objective was to understand the operational, behavioral, and economic aspects of dark stores in transforming the last-mile delivery concept. A detailed review practice was then established, defining the scope, keywords, and through inclusion/exclusion criteria. Since it's an evolving concept, there are studies still on going related to dark stores and quick stores. The review focused on studies published between 2021 and 2025, specifically targeting peer-reviewed articles that explore intersections among quick commerce, last-mile delivery, consumer behavior, and logistics innovation.

A systematic literature article search was carried out across reputable databases, including Emerald, Science Direct, SSRN Electronic Journal, Journal of Supply Chain Management, Research in Transportation Economics, Transportation Research Procedia, and Google Scholar. An initial pool of 50 studies was shortlisted based on titles, abstracts, and relevance to the topic. After removing duplicates and filtering according to inclusion criteria, 45 core articles were retained for full review. These were analyzed to determine recurring themes and insights. Citation tracking was used to identify additional influential papers, ensuring comprehensive coverage. Using VOSviewer, a keyword bibliometric analysis was conducted to visualize major themes and Inter connections. The analysis revealed three major thematic clusters: operational efficiency (e.g., logistics automation, delivery-on-demand), consumer behavior (e.g., convenience, satisfaction), and economic challenges (e.g., cash burn, pricing strategies), all converging around the core concept of quick commerce.

The findings were synthesized to highlight how dark stores act as vital enablers of Q-commerce for optimizing logistics or last-mile delivery while also addressing consumer expectations. The review uncovers critical insights into operational dynamics, evolving consumer preferences, and the economic sustainability of dark store models. This structured approach provides a foundational understanding of dark stores' role in revolutionizing last-mile delivery and lays the groundwork for future evidence-based analysis.

Methodology

Number of Articles

Analysis and Findings Descriptive Analysis

A total of 45 research articles were deemed eligible for descriptive analysis. Figure 2 illustrates the year-wise distribution of these publications, highlighting the growing academic interest in the domains of dark stores and quick commerce. This distribution indicates that the topic remains highly relevant, as it is still emerging and evolving in response to technological advancements and also changing consumer behaviors. Notably, there has been a significant increase in related research over the years, reflecting its rising importance in supply chain, retail, and logistics literature. Among the selected studies, 20 articles — accounting for approximately 44% were published in 2024 alone, indicating a sharp surge in scholarly attention during this period. In contrast, 10 articles (around 22%) were published in 2022, followed by 8 publications (just over 17%) in 2023. The fluctuation in publication numbers over the years can be attributed to the dynamic nature of the topic. As quick commerce and dark store models gained traction during and after the COVID-

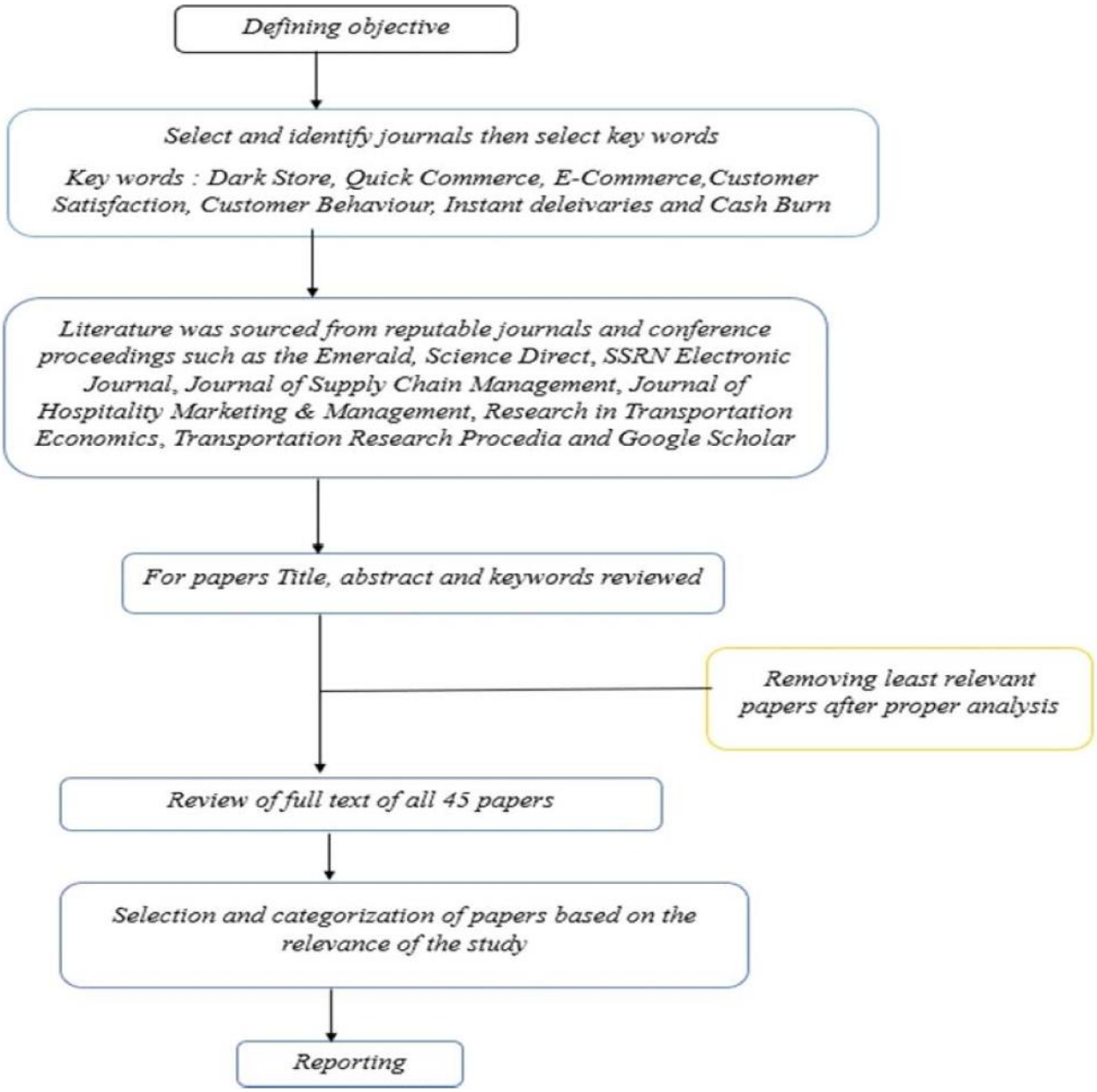

Figure 1: Systematic Literature Review (SLR)

19 pandemic, researchers began exploring their implications more thoroughly. The spike in 2024 likely reflects both the maturation of the field and an increased availability of real-world data, enabling more comprehensive and timely studies.

Cited Articles

Ten of the most highly cited articles from the 45 selected studies were analyzed, as detailed in the accompanying table. Among the highest cited articles titled "Modeling Consumers' Trust in Mobile Food Delivery Apps: Perspectives of Technology Acceptance Model, Mobile Service Quality and Personalization-Privacy Theory" (with 133 citations) stands out for its comprehensive approach to understanding trust in mobile food delivery apps (MFDAs).The study is one of the first to empirically explore how TAM factors, mobile service quality, and privacy-personalization balance influence customer trust and, in turn, lead to loyalty.

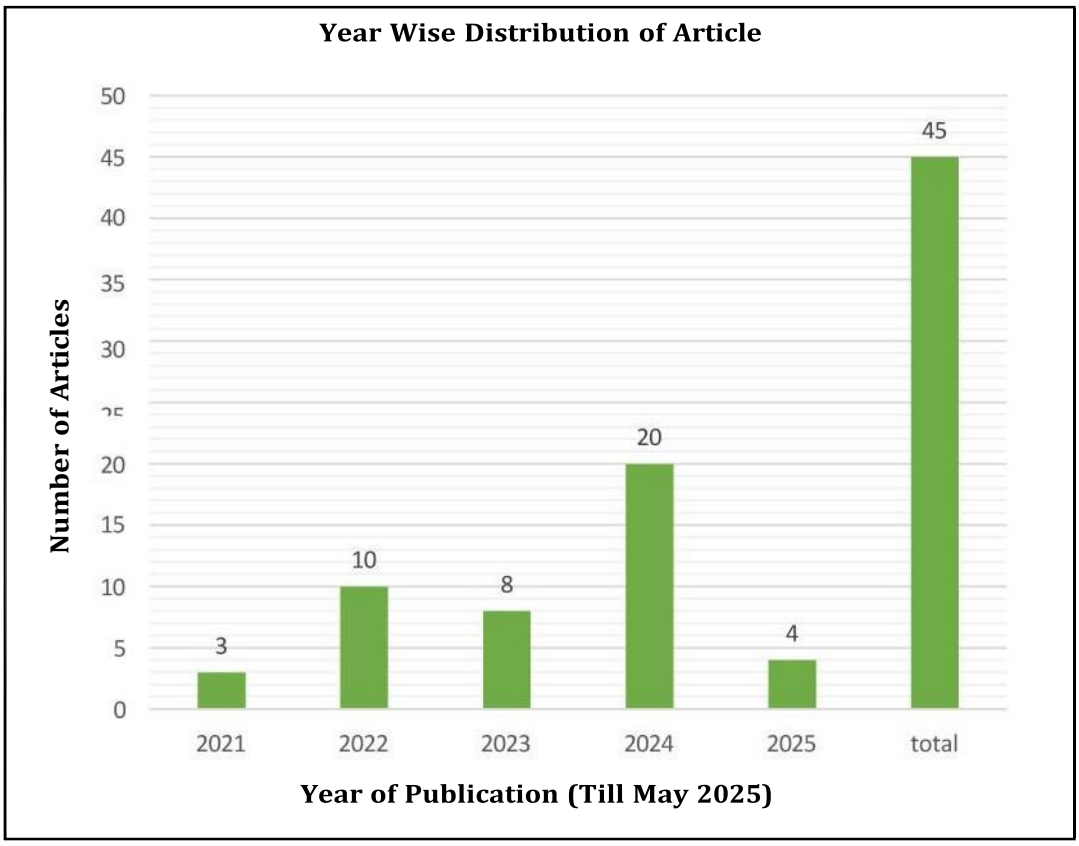

Figure 2: Year-wise Distribution of Articles

By integrating multiple theoretical frameworks rather than treating them in isolation, the paper provides a holistic model that connects trust formation to behavioral outcomes. It also offers practical insights into app design, real-time information quality, and data handling, all critical in the context of rising mobile food delivery use. Its broad theoretical contribution, practical relevance, and timely focus on digital trust are key reasons behind its high scholarly impact and citation count.

The article *"Platform urbanism in a pandemic: Dark stores, ghost kitchens, and the logistical-urban frontier"* (117 citations on Google Scholar) offers a critical lens into how pandemic-era innovations like dark stores have reconfigured urban infrastructure and investment logic. The research reveals that while dark stores promise immediate logistical gains through accelerated delivery models, they are also deeply related to speculative finance, which is operating more a sunstable financial assets than infrastructure. Its high citation Count reflects the article's timely insight into the dual nature of "going dark", as both a pandemic response and a speculative strategy reshaping urban economies.

The article *"Last-Mile Delivery Methods in E-Commerce: Does Perceived Sustainability Matter for Consumer Acceptance and Usage?"* (41 citations) offers a complex examination of consumer attitudes toward sustainable delivery methods by integrating the Technology Acceptance Model (TAM) with the triple bottom line of sustainability, which measures business success. The study highlights that while environmental sustainability positively influences consumer attitudes, it mainly focuses on home delivery and parcel lockers for convenience, perceived usefulness, and perceived ease of use remain the strongest drivers of acceptance. Its growing citation count reflects its valuable contribution to the evolving discourse on sustainable logistics, bridging economic, environmental, and social factors with behavioral adoption models.

Table 1: Cited Articles from Google Scholar Citation as on 10.05.2025

Sl. No.	Title	Number of Citation
1.	Modeling consumers' trust in mobile food delivery apps: perspectives of the technology acceptance model, mobile service quality, and personalization-privacy theory	133
2.	Platform urban is min a pandemic: Darkstores, ghost kitchens, and the logistical-urban frontier	117
3.	Last-Mile Delivery Methods in E-Commerce: Does Perceived Sustainability Matter for Consumer Acceptance and Usage?	41
4.	Dark stores in the City of Light: Geographical and transportation impacts of 'quick commerce' in Paris	33
5.	Driving Forces for Digital Transformation–Case Studies of Q-Commerce	24
6.	The Advantages and Limitations of e-Commerce to both Customers & Businesses	19
7.	A Study on Emergence of Quick Commerce	18
8.	Q-Commerce – The Next Generation E-commerce	18

Network and Cluster Analysis

To deepen the understanding of the intellectual structure and thematic evolution within the domain of dark stores and quick commerce, a bibliometric network analysis was conducted using VOSviewer. Based on keyword co-occurrence from a selective compilation of 45 scholarly articles retrieved from the Scopus database that leads to the resulting visualization (Figure 2) maps the conceptual landscape of this emerging field. The visual network highlights the most repeated and interconnected terms within the literature. It was found that "quick commerce" is emerging as the dominant node, which indicates that it plays the central role in ongoing academic study. The net- work is visually divided into three major thematic clusters, and they are Operational and Logistical Infrastructure (Red), Consumer Behavior and Perception (Green), and Fresh Product Commerce (Blue), each representing distinct yet interrelated streams of inquiry.

Cluster1: Operational and Logistical Infrastructure of Quick Commerce (Red Cluster)

The red cluster summarizes that the operational core of quick commerce focuses heavily on logistics and supply chain mechanisms. Prominent terms in relation to it include dark store, e-commerce, e-grocery, last-mile delivery, ultrafast delivery, instant deliveries, automation, logistics, last-mile logistics, and cash burn.

These keywords indicate a strong emphasis in literature based on the infrastructural backbone that enables the swift fulfillment of orders as a defining characteristic of quick commerce. Dark stores, often converted retail spaces or purpose lead to the built of micro-warehouses, are positioned as central enablers of last-mile delivery efficiency, inventory management, and automated picking and dispatching. Their role is particularly critical in dense urban environments where space and delivery times are constrained.

The presence of cash burn among the keyword signals rising academic attention to the financial sustainability of quick commerce startups. This includes critiques of profitability models and analyses of the high operational costs associated with ultrafast delivery systems (Ganapathy & Gupta, 2023). Furthermore, the integration of automation and logistics into this cluster emphasizes the technological drive

toward reducing human intervention, thereby improving scalability and reducing errors. This cluster affirms that dark stores are not merely physical infrastructures but strategic assets redefining the speed, efficiency, and economic models of retail distribution.

Cluster 2: Consumer Behavior and Perception (Green Cluster)

The green cluster addresses the demand-side perspective, focusing on how consumers perceive and interact with quick commerce services. This cluster includes key terms such as consumer behavior, customer satisfaction, pricing, convenience, product variety, purchase decisions, perceived ease of use, e-trust, e-WOM (electronic word-of-mouth), and repurchase behavior. This thematic area is anchored in marketing, digital trust, and user experience research, highlighting the role of personalization, usability, and value-for-money in shaping consumer preferences (Astini et al., 2024).The prominence of convenience and pricing indicates that consumers are making transactional decisions based on the trade-off between delivery speed, product availability, and overall cost (Darji et al., 2024).

The link between customer satisfaction, repurchase behavior, and e-WOM reveals a positive feedback relation wherein satisfied users advocate for the service, further boosting consumer trust and engagement. These interrelations illustrate that successful last-mile delivery models must address not only speed and logistics but also emotional and psychological elements of trust, ease, and digital satisfaction. This cluster's proximity to the central node, "quick commerce," reinforces that consumer-centric factors are critical to the sustainability and scalability of these platforms.

Cluster 3: Fresh Product Commerce (Blue Cluster)

The blue cluster, though smaller and more specialized, reflects growing academic interest in the niche domain of fresh agricultural products delivered via quick commerce platforms. Dominant terms include fresh agricultural products, online purchase intention, and online reviews.

This research thread investigates how product freshness, review reliability, and consumer trust influence online buying behavior for perishable goods. Given the complexity of handling and delivering items like fruits, vegetables, and dairy under strict temperature and time constraints, this cluster represents a unique challenge within the larger quick commerce framework (Wang et al., 2022). Its relative isolation from the green cluster suggests that while these topics are consumer-oriented, they involve distinct logistical considerations, such as special storage, real-time quality monitoring, and localized fulfillment, which go beyond the typical e-commerce concept.

Keyword Frequency Analysis

Based on the analysis of the 45 selected research articles and the corresponding keyword co-occurrence network (Table 2) and frequency data, the most repeated keyword is **"quick commerce"**, occurring around 30 times with a total link strength of 35. This reflects the core focus of the present research on rapid delivery models in the retail sector (Mukhopadhyay, 2024). Closely related is **"dark store"**, appearing 11 times with a strong link strength of 23, highlighting its central role in enabling quick commerce operations through localized fulfillment centers (Ganapathy & Gupta, 2023). **"E-commerce"** (14 occurrences, link strength 22) and **"e-grocery"** (9 occurrences, link strength 15) also frequently appear, emphasizing the integration of dark stores into broader digital retail ecosystems. Operational terms like **"last mile delivery"**, **"logistics"**, and **"convenience"** (each with 4 occurrences) show recurring scholarly concern around fulfillment efficiency and consumer experience, while **"consumer behavior"** (4 occurrences, link strength 5) under scores the psychological and decision-making aspects of online shopping behavior (Astini et al., 2024). These frequent keywords indicate the academic community's consistent interest in how infrastructural innovation (dark stores) and customer-centric strategies converge to revolutionize last-mile delivery, aligning closely with the study's focus.

Discussion

The systematic literature review uncovers the transformative impact of dark stores within the quick commerce (Q-commerce) landscape, high-

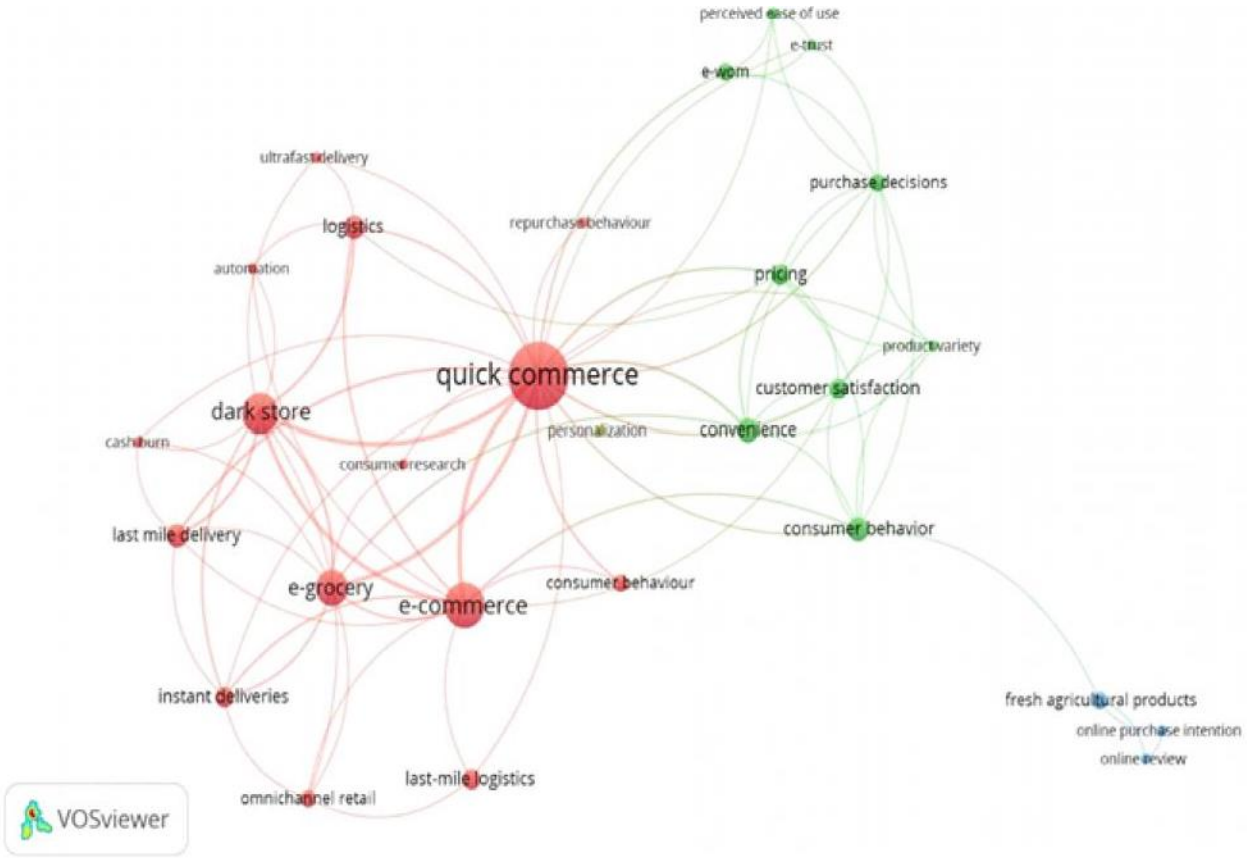

Figure 2: Bibliographic Coupling of Keywords Quick Commerce and Dark Stores

Table 2: Keyword Frequency Analysis

Sl. No.	Keywords	Occurence	Total Link Strength
1.	Quick Commerce	30	35
2.	Dark Store	11	23
3.	E-Commerce	14	22
4.	E-Grocery	9	15
5.	Last mile delivery	4	8
6	Convenience	4	7
7	Logistics	4	7
8	Consumer behavior	4	5

lighting their strategic importance in reshaping last-mile delivery and retail infrastructure. As the core enablers of Q-commerce, dark stores function as hyper-local, tech-enabled micro-fulfillment centers that facilitate ultrafast deliveries by optimizing inventory management and minimizing delivery lead times (David et al., 2024). Positioned strategically in urban settings, these stores play a pivotal role in reducing the friction between order placement and fulfillment, thus addressing the growing consumer demand for immediacy, convenience, and reliability. The network and

cluster analyses from this review identify three dominant thematic are as and they are logistics infrastructure, consumer behavior, and economic feasibility, and each is interlinked through the central node of" quick commerce." On the operational front, dark stores enhance logistic fast movement and support automation-driven processes, including robotic picking and real-time dispatching. From a consumer perspective, factors such as perceived ease of use, service personalization, and convenience emerge as significant motivators for adoption, contributing to increased satisfaction and repeat purchase behavior (Astini et al., 2024; Darji et al., 2024). However, the model's scalability is constrained by persistent financial concerns, particularly the "cash burn" associated with maintaining dark store networks and delivery infrastructure (Ganapathy & Gupta, 2023). While the current trajectory of Q-commerce demonstrates strong potential in densely populated markets, long-term sustainability requires innovative solutions to address operational inefficiencies and profitability gaps. Thus, darkstores stand at the inter section of logistical innovation and consumer-centric service, but their continued success depends on strategic adaptation and economic resilience.

Conclusion

The evolution of dark stores as integral components of quick commerce (Q-commerce) represents a paradigm shift in the structure and strategy of the retail system and last-mile logistics. Function in gas hyper local, tech-enabled micro-fulfillment centers, dark stores have empowered platforms to deliver products those are especially groceries and fresh produce those with unmatched speed and accuracy. Their emergence responds directly to the modern consumer's demand for immediacy, convenience, and reliability, a trend accelerated by the COVID-19 pandemic and supported by rapid digitalization. This transformation has allowed Q-commerce players to align more closely with the expectations of digitally native generations, particularly Gen Z.

This systematic review, through bibliometric and cluster analysis, highlights that dark stores operate at the intersection of three key thematic domains: operational infrastructure, consumer behavior, and economic viability. While they have significantly enhanced logistical movement and improved customer satisfaction, concerns about long-term sustainability persist. High operational costs, intense competition, and unsustainable cash burn have raised critical questions about profitability and scalability, especially for startups operating in densely populated and price-sensitive markets.

To secure their place in the future of Q-commerce, dark stores must transition from being purely tactical delivery points to becoming strategically managed, intelligent hubs. Embracing automation, predictive analytics, and AI-driven inventory management can improve efficiency and reduce operational strain. Furthermore, aligning with Sustainable practices and leveraging data for personalized consumer engagement will be crucial. In essence, dark stores have the potential to redefine urban retail infrastructure, but only if they evolve with innovation, financial resilience, and a deep commitment to serving the modern, digitally empowered consumer.

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