The current issue and full text archive of this journal is available on Emerald Insight at:
https://www.emerald.com/insight/2690-6090.htm

Q-commerce or E-commerce? A systematic state of the art on comparative last-mile logistics greenhouse gas emissions literature review

Received 5 January 2023
Revised 31 May 2023
Accepted 20 June 2023

Harshal Pandurang Gund
Centre for Supply Chain Improvement, College of Business, Law and Social Sciences, University of Derby, Derby, UK, and
Jay Daniel
Derby Business School, University of Derby, Derby, UK

Abstract

Purpose – The purpose of this study is to systematically review available state-of-the-art literature on comparative studies on Quick Commerce (Q-commerce) and E-commerce and their greenhouse gas (GHG) emissions.

Design/methodology/approach – The literature survey methodology is based on the funneling approach of Kitchenham (2004), where results are obtained according to inclusion and exclusion criteria. The literature review methodology used for this study covers the period from 2016 to 2022. The areas considered for the survey are operations, logistics and supply chain network design for the distribution of goods in e-business. After deciding on the criteria, a total of 140 articles were extracted from 9 journal articles that study e-commerce and environmental emissions.

Findings – The result of this study reveals that GHG emissions from both modes of shopping depend on various parameters such as speed of delivery, last-mile depot locations, logistics and vehicle efficiency, customers' order patterns and average basket size. Furthermore, the findings also highlight the difference between Q-commerce and E-commerce supply chain networks.

Research limitations/implications – This study only accounts for GHG emissions from logistics activities, but there are other sources of GHG emissions in the overall supply chain that are not taken into consideration. Supply chain/business analysts in Q-commerce companies might refer the findings from this study to measure GHG emissions from their operations.

Originality/value – This is the first study in the Q-commerce field that uses a structured approach to find relevant literature from the years 2016 to 2022 and focuses on GHG emission measurement.

Keywords Q-commerce/E-commerce, Last-mile logistics, Greenhouse gas (GHG), Emission comparison, Systematic literature review

Paper type Literature review

1. Introduction

After global economic developments and population growth in the 1980s, greenhouse gas (GHG) emissions spiked rapidly, with industrial and transportation activities and their reliance on fossil fuels being the primary cause (Sydney *et al.*, 2019). After surviving the dot-com bubble in 2000, retail companies worldwide experienced strong growth in e-retail

© Harshal Pandurang Gund and Jay Daniel. Published in *International Journal of Industrial Engineering and Operations Management*. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at http://creativecommons.org/licences/by/4.0/legalcode

International Journal of Industrial Engineering and Operations Management
Vol. 6 No. 3, 2024
pp. 185-207
Emerald Publishing Limited
e-ISSN: 2690-6104
p-ISSN: 2690-6090
DOI 10.1108/IJIEOM-01-2023-0001

sales due to Internet penetration. In 2020, retailers experienced similar growth in FMCG (Fast Moving Consumer Goods) and grocery sales through Q-commerce, delivering groceries in less than 30 min.

Quick Commerce, also known as Q-commerce, is a subset of E-commerce that focuses on providing fast and efficient delivery of goods to consumers. It involves the use of advanced technology and logistics systems to enable businesses to offer delivery of products within hours or even minutes of an order being placed. In Q-commerce, the emphasis is on speed and convenience for the customer, with the goal of providing a seamless and frictionless shopping experience. This is achieved through the use of dark stores, which are small warehouses designed to fulfil orders quickly, as well as automated warehouses, real-time inventory management and efficient last-mile delivery networks that leverage the latest in logistics technology.

Due to environmental issues, economies and enterprises worldwide are focusing on controlling and restructuring their supply chain and logistics activities. Customer awareness about GHG emissions is forcing enterprises to adopt a more environmentally sound supply chain and logistics strategy. Due to the dynamic nature of retail businesses, it is not easy for policymakers and business leaders to achieve sustainability goals and design operations accordingly. Currently, the life cycle of Q-commerce is in the introduction and growth phases. In the UK, the gross value added of the transportation and storage sector increased from £66.9bn in 2020 to about £72.3bn in 2021 due to the growth of E-commerce and last-mile logistics (Clark, 2022). Gross business-to-consumer (B2C) merchandise sales in 2019 were £197.1bn, representing a 7% increase from the previous year (Coppola, 2022). During the COVID-19 pandemic, e-retailing accounted for 38% of total retail sales in the UK. With this impressive market share, the E-commerce supply chain model has been well-optimised for the last two decades to reduce last-mile emissions. In the introduction phase of Q-commerce, businesses are trying to lower their emissions to attract environmentally conscious customers in tier 1 cities.

According to Fisher (1997), there are two types of products: functional and innovative, and a supply chain strategy should align with business goals. Food and groceries are considered functional products, where demand is predictable, and the supply chain design aims to fulfil demand at the lowest cost by optimising operations. Logistic costs are kept down by consolidating deliveries from warehouses to destinations (Chopra, 2019). Availability, cost, time and convenience are the top key performance indicators that food retail businesses need to control to sustain themselves. To provide more convenience to customers, retailers have improved distribution through home delivery. With Internet penetration in all areas and technological advancements, customers are willing to shop through both modes, by visiting stores and home delivery. The hybrid combination, called the omnichannel supply chain, serves customer needs more efficiently (Chopra, 2019a, pp. 97–110). In the omnichannel approach, there are two different supply chain strategies: online order pickup from the store and online order home delivery.

A study on GHG emission measurement was conducted in 2015 by Mangiaracina *et al.* (2015). The survey examined transportation planning, warehousing and operations, and packaging for B2B (Business-to-business) and B2C online shopping, with a major focus on parameters for measuring environmental impacts. The factors analysed through the literature review included vehicle mileage, waste generated, and gas and electricity generation from storage facilities. The study also investigated green initiatives taken by enterprises, such as the use of electric vehicles, less polluting engines for trucks and solar-powered warehouses.

Another study by Viu-Roig and Alvarez-Palau (2020) focused on last-mile logistics impacts on the environment and city traffic in 2020. This study highlighted the need for efforts to reduce environmental impacts resulting from online shopping's last-mile logistics. The study discussed efforts such as process improvement, technology upgrades, GPS and real-time data collection, Internet of Things and traffic management systems, self-pickup services, drone-based deliveries, and the use of delivery optimisation algorithms and electronic cargo bikes. There is also a study by Feichtinger and Gronalt (2021), which primarily focused on a comparative analysis of GHG emissions from in-store and online shopping. The study compared the measurement parameters, emission calculation approaches, and formulas used in various literature reviews.

As Q-commerce is a relatively new concept, there is a literature gap regarding the lack of academic research and scholarly publications on this topic. While there has been some coverage in the media and industry reports, limited scholarly research investigates the key drivers, challenges and opportunities of Q-commerce. Particularly, in Q-commerce and last-mile logistics GHG emissions areas, no study has been done to the best of the authors' knowledge. Given the environmental impact of last-mile logistics and transportation in the supply chain, there is a need for research that explores key factors for measuring GHG emissions and compares Q-commerce and E-commerce and their GHG emissions. Overall, there is significant potential for academic research in this theme, and it is an area that is likely to attract more attention as the market continues to grow and evolve.

To add more value to customers, many retailers have started Q-commerce services for more convenience and faster delivery. In Q-commerce delivery, retailers aim to solve critical problems in inventory planning, analysing order patterns and setting up appropriate last-mile delivery networks with the help of technology. The UK has pledged to reach net zero carbon emissions by 2050 under the COP26 agreement. According to recent research by IBM on 18,980 customers about their purchase preferences for groceries, 57% of customers are willing to change their purchasing habits to reduce their environmental impact. Moreover, 45% of customers prefer retail brands that produce less harm to the environment (IBM, 2020). Supply chain and logistics strategies need to be focused on achieving these requirements.

Therefore, the purpose of this study is to investigate the link between Q-commerce and GHG emissions, as well as future research prospects, by addressing the following research questions:

RQ1. What is the difference between order patterns for Q-commerce and traditional home delivery?

RQ2. What are the differences between the logistics network and infrastructural requirements of Q-commerce and E-commerce?

RQ3. What are the key factors to consider when measuring GHG emissions in last-mile logistics?

Therefore, this study aims to address the literature gap by systematically classifying articles, summarising their dominant themes, analysing the evolution of published literature over time and providing guidance for future studies that meet the needs of both researchers and practitioners. The study contributes to the Q-commerce and logistics literature by providing a comprehensive overview of key concepts and by comparing Q-commerce and E-commerce in terms of their GHG emissions. It also highlights key factors for measuring last-mile logistics GHG emissions in the context of Q-commerce and E-commerce, thereby enhancing scholars' understanding of the growth of emerging topics in this field. The results have significant implications as they enable future research to tackle the inherent complexity of Q-commerce and last-mile logistics GHG emissions concepts and suggest possible directions for future studies.

The remainder of the paper is structured as follows. Section 2 elaborates on the research methodology for the systematic literature review. Section 3 presents the key findings of the study and discusses the main themes. Sections 4 and 5 synthesise the findings and present the future research agenda, and the discussion and conclusion. This paper is the first contribution towards a dissertation of Master's degree in Global Operations and Supply Chain Management programme at the University of Derby.

2. Research methodology

As discussed in the previous section, due to the relatively new nature of Q-commerce, there is a gap in the existing literature regarding academic research and scholarly publications on this topic. Although there has been some coverage in the media and industry reports, limited scholarly research has been conducted to investigate the main drivers, challenges and opportunities of Q-commerce. Specifically, there is a dearth of studies exploring Q-commerce and last-mile logistics GHG emissions. To the best of the authors' knowledge, no research has been undertaken in this area. Considering the environmental impact of last-mile logistics and transportation in the supply chain, it is essential to conduct research that examines the key factors involved in measuring GHG emissions. Furthermore, a comparison between Q-commerce and E-commerce in terms of their respective GHG emissions is also lacking. This highlights the necessity for academic research to address these gaps. Overall, there is significant potential for academic research in this field, which is likely to garner more attention as the market continues to expand and develop.

This study uses a literature survey method for Q-commerce online shopping and its environmental impact, which is based on (Kitchenham, 2004) literature review method.

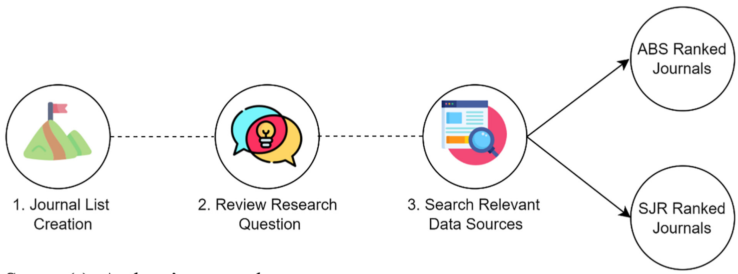
This research was conducted in three phases: (1) development of a list of journals; (2) extraction of data sets and (3) analysis of key findings.

2.1 Journal list development

In the process of developing the research journal, the research objective/questions and related research categories have been thoroughly reviewed (see Figure 1). The journal ranking criteria used are those of the Association of Business Schools (ABS) and SCImago Journal Rank (SJR). The ABS publishes a guide to academic publications in business and management, which includes a list of all relevant journals that have been evaluated and assigned a star rating to indicate their quality. The SJR indicator measures the scientific impact of an academic publication by considering both the number of citations received and the prominence or prestige of the journals from which the citations are obtained. To assess the reputation of both individual researchers and their institutions, the ABS ranking is widely used (Salter *et al.*, 2017) that's why we have decided to employ the ABS ranking for the systematic literature review. After applying the ranking filter to the journals, a total of nine journals were selected that work in the areas of supply chain management, operations research, logistics management, transport management, sustainability and cleaner production. Table 1 illustrated the list of ranked journals selected for the study.

2.2 Data set extraction

In order to obtain relevant articles from the list of journals, the paper extraction process began with the establishment of appropriate inclusion and exclusion criteria. The criteria are as follows:



Source(s): Authors' own work

Figure 1.
Journal list creation process

No.	Journal name
1	International Journal of Physical Distribution & Logistics Management
2	Environmental Science & Technology
3	Transportation Research Part D
4	Journal of Cleaner Production
5	Journal of Transport Geography
6	Journal of Operations Management
7	European Journal of Operational Research
8	Transportation Research Part E: Logistics and Transportation Review
9	Supply Chain Management

Source(s): Authors' own work

Table 1. Journal list

(1) The paper must have been published within the last five years.

(2) The area of study mentioned must be online shopping or e-retailing.

(3) The study conducted in the article is to measure GHC emissions or carbon footprints.

Relevant publications were found in selected journals using the keywords "online shopping" and "carbon footprints in e-shopping". Three filtering procedures were used to ensure that 140 studies from nine journals met the relevance requirements. In the first filtering process, 65 articles were filtered out of 140 articles. In the second filtration, after reviewing the abstract and introduction of the research article, a total of 43 articles were extracted from 140. In the third stage of filtration, out of 43, only 19 articles remained according to the above criteria. The filtration process is explained in Table 2.

The retrieved articles are listed in Table 3. Also, the number of articles in each study area is shown in Figure 2.

3. Key findings from the literature

This section presents and analyses the results of the studies. The papers included in the current systematic review are examined in terms of their characteristics. It also evaluates the

No.	Journal name	Publisher	Initial paper no.	Final paper no.
1	International Journal of Physical Distribution & Logistics Management	Emerald	24	2
2	Environmental Science & Technology		12	2
3	Transportation Research Part D	Elsevier	9	6
4	Journal of Cleaner Production	Elsevier	17	4
5	Journal of Transport Geography	Elsevier	3	1
6	Journal of Operations Management	Science Direct	28	1
7	European Journal of Operational Research	Science Direct	25	1
8	Transportation Research Part E: Logistics and Transportation Review	Elsevier	18	1
9	Supply Chain Management	Emerald	4	1
Total number of articles			140	19

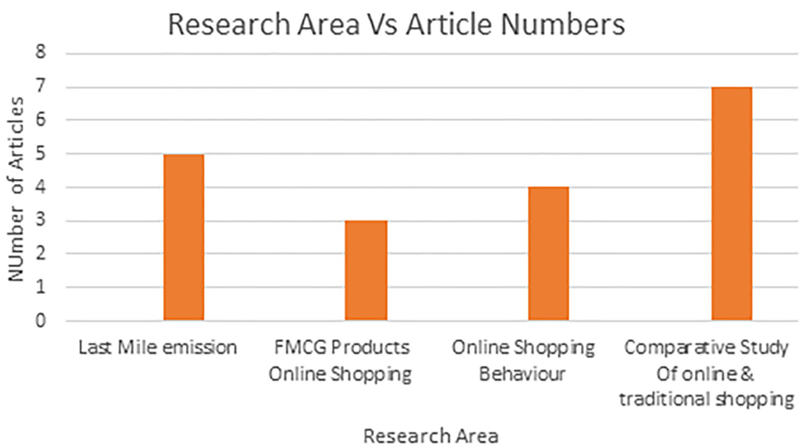
Source(s): Authors' own work

Table 2. Data set extraction

No.	Article name
1	A comparative analysis of carbon emissions from online retailing of fast moving consumer goods
2	The Environmental Impact of Transport Activities for Online and In-Store Shopping: A Systematic Literature Review to Identify Relevant Factors for Quantitative Assessments
3	Carbon Auditing the "Last Mile": Modelling the Environmental Impacts of Conventional and Online Non-food Shopping
4	Comparative analysis of the carbon footprints of conventional and online retailing: A "last mile" perspective
5	Comparative carbon auditing of conventional and online retail supply chains: A review of methodological issues
6	Comparative Greenhouse Gas Footprinting of Online versus Traditional Shopping for Fast-Moving Consumer Goods: A Stochastic Approach
7	Effects of E-Commerce on Greenhouse Gas Emissions: A Case Study of Grocery Home Delivery in Finland
8	Evaluating the environmental impacts of online shopping: A behavioural and transportation approach
9	Measuring transport related CO_2 emissions induced by online and brick-and-mortar retailing
10	The net environmental impact of online shopping, beyond the substitution bias
11	Bricks or clicks? Consumer channel choice and its transport and environmental implications for the grocery market in Norway
12	The Impact of E-Commerce-Related Last-Mile Logistics on Cities: A Systematic Literature Review
13	Transport-related CO_2 effects of online and brick-and-mortar shopping: A comparison and sensitivity analysis of clothing retailing
14	A review of the environmental implications of B2C e-commerce: a logistics perspective
15	Critical analysis of carbon dioxide emissions in a comparison of e-commerce and traditional retail
16	Environmental Analysis of US Online Shopping
17	Retail Carbon Footprints: Measuring Impacts from Real Estate and Technology
18	The Net Effect: Environmental Implications of E-Commerce and Logistics
19	E-Commerce: Sorting Out the Environmental Consequences

Source(s): Authors' own work

Table 3.
Extracted articles



Source(s): Authors' own work

Figure 2.
Study area of articles

differences between the logistics network and infrastructure requirements of Q-commerce and E-commerce. Furthermore, to address the research questions, the key findings from the literature categorised into nine areas include retail E-commerce, E-commerce supply chain network, retail Q-commerce, Q-commerce supply chain network, grocery items bucket size and return/undelivered order rates, environmental impact of logistics GHG emissions, point of divergence, parcel drop density and vehicle miles travelled (VMT), and population density. The analysis also includes an examination of the factors that influence the measurement of GHG emissions in last-mile logistics.

3.1 Retail E-commerce

Jewels and Timbrell (2001) define E-commerce as "the seamless integration of information and communication technologies throughout the value chain of commercial processes that are conducted electronically and are designed to facilitate the achievement of a business objective". E-commerce is simply the buying and selling of physical goods and services over the Internet. E-commerce works in two segments, one is the business firm electronically serves the other firm is B2B, and the other is the seller serves the end customer is counted in B2C (Yu *et al.*, 2016a, b). Globally, retail E-commerce is scaled in two models, one is product-based, where the manufacturer sets up its own online infrastructure and delivers products through logistics service providers such as 3PL (e.g. Nike.com, tesco.com), and the other is marketplace-based, where sellers list their products on the website of a third party and the seller is responsible for physical distribution, marketing and payment (e.g. amazon.co.uk, ebay.com, shopify.com) (Pi and Wang, 2020). The main difference between E-commerce and traditional brick and mortar (B&M) retail chains is the wide availability of products from global sellers in e-tailing. From a logistics network design perspective, the final address of the individual customer's home adds complexity compared to B&M stores. Wygonik and Goodchild (2012) looked at various aspects to study the environmental impact but highlighted the impact due to shopping behaviour and product variety. The regular grocery sector has potentially high GHG emissions compared to irregularly purchased items, such as electronics.

3.2 E-commerce supply chain network

Online grocery retailers are often divided into two types. The first is the store-based player, which has an offline presence as well as accepting online orders and delivering through nearby stores. The second type is the pure-play player, which only accepts customer orders from the website and delivers through its regional warehouse (Shahmohammadi *et al.*, 2020). As both players have different logistics networks, their environmental impacts are also different. For our thesis, we analyse the supply chain network of a pure-play E-commerce player. Tehrani (2005) found an 88% reduction in fuel consumption and a 25% reduction in emissions when personal visits to the grocery store are replaced by consolidated home delivery of multiple grocery orders. The total GHG emissions do not include the contribution of storage facilities and packaging, the potential share of which is captured by logistics activities, which largely depend on the logistics mode, the country's infrastructure, transport regulations and customer-related factors (e.g. bucket size, location, population density and delivery time). Figure 3 shows a typical E-commerce logistics network.

The E-commerce logistics network is divided into upstream and downstream transport. Upstream transport is initiated from the manufacturer's factory to the central warehouse to regional fulfilment centres to the last-mile sorting centre. Shahmohammadi *et al.* (2020) referred to the transport activity from the manufacturer's factory to the central warehouse as primary logistics. The secondary logistics journey started from the central warehouse and ended at the regional fulfilment centres. Due to economies of scale, 25-tonne articulated vehicles are used in this phase. The next stages operate on a hub and spoke model where orders are prepared in the regional hubs and sent to the local sorting centre by postcode, which is referred to as tertiary logistics and parcels are transported in the rigid vehicle (10–17

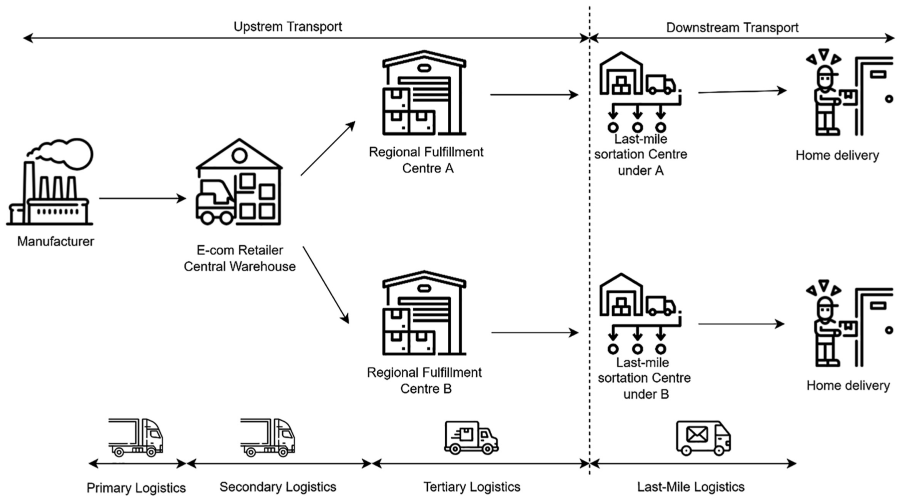


Figure 3.
E-commerce transport activities

Source(s): Edwards *et al.* (2010b)

tonnes). The next stage is downstream logistics, the last mile of transport. Parcels were sorted at local hubs, then loaded into vans (7.5 tonne capacity) and sent to the assigned area under a postcode. If the parcels are not delivered, failed deliveries and returns, usually from customers dissatisfied with the quality/performance of the products, are returned in the reverse direction to the retailer's processing centre.

3.3 Retail Q-commerce

Q-commerce is referred to as third-generation commerce, which includes the activity of buying and selling physical goods using the Internet, with delivery times typically less than 60 min (Bommireddipalli, 2022). The COVID-19 epidemic has given the UK Q-commerce sector an extra boost, increasing its projected size to around £1.4bn by 2021 (Chevalier, 2022). The global Q-commerce market is estimated to be worth $17bn in 2021 and is expected to grow to $72bn by 2025 after a boost from the COVID wave. The potential accelerators are the post-COVID lifestyle change, where customers are willing to pay extra for home delivery, an increase in traffic congestion in cities, an ageing population in Western countries and an increase in disposable income. According to one report (Bogdanova, 2021), 30 new Q-commerce companies were registered in Western Europe in 2020, and one of them, called Gorillas, reached unicorn start-up status in just nine months. Bogdanova (2021) divides Q-commerce into two types. First is hyperlocal delivery services (e.g. Uber Eats, Just Eat, Deliveroo), which are an asset-light model, owning only a data-driven technology network and delivery workforce, in which they partner with traditional retailers in exchange for a commission per order delivered to get goods to customers in less than 60 min. Second, ultra-fast delivery services (e.g. Gorillas, Gopuff, Getir), which are new start-ups that own the delivery workforce, small grocery warehouses across the city and technologically advanced IT infrastructure to deliver products from their own warehouses in less than 30 min. This fast delivery target was achieved by setting up small warehouses with a capacity to store 2,500 Stock Keeping Units (SKUs) every 4–6 km (kilometre) across the city, called dark stores.

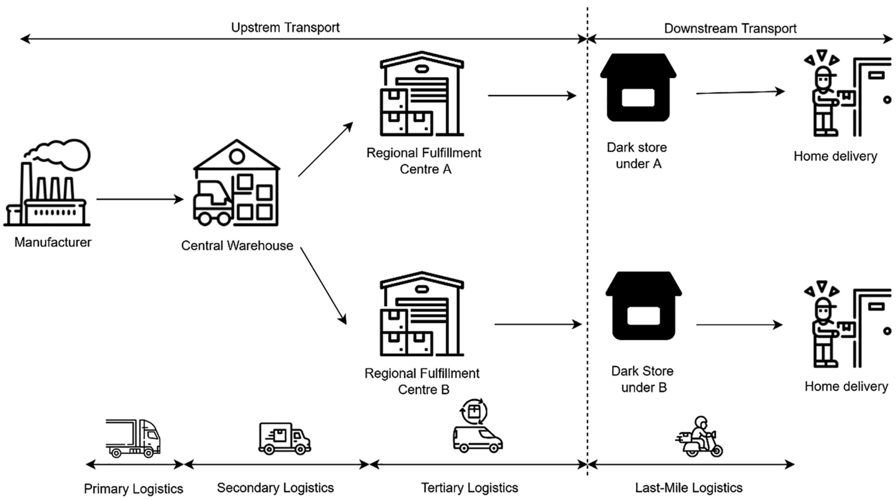
3.4 Q-commerce supply chain network

As mentioned above, Q-commerce is currently mostly limited to the delivery of fresh food and groceries, which are perishable in nature, so logistics activities are more reactive. Dark store products are often replenished in small batches after the system automatically detects that SKU levels have fallen below a certain threshold. As shown in Figure 4, the difference between E-commerce and Q-commerce is the mode of transportation (Younes *et al.*, 2022; Li *et al.*, 2008). Primary transport is carried out by a 25-tonne articulated vehicle, where the retailer has sufficient economies of scale. Secondary transport, in which bulk goods are transported from central to regional facilities according to demand, is carried out by rigid vehicles with a capacity of 15 tonnes (Bogdanova, 2021). The third stage of upstream logistics is called tertiary logistics, in which small batches of perishable food and other goods are loaded into a 7-tonne van. This upstream logistics ends with the delivery of goods to several dark stores located throughout the city. Q-commerce's last-mile delivery is very different from E-commerce, where multiple parcels are delivered in a single trip. One or two grocery orders are delivered from the dark store to the customer's home in a single trip. A customer's order is automatically routed to the nearest dark store and an available delivery driver is notified to pick up the processed order from a dark store, where the driver's system intelligently synchronises traffic data and shows the quickest route from store to home.

3.5 Grocery items bucket size and return/undelivered order rates

Siragusa and Tumino (2021) focus on the e-grocery industry, which distinguishes the difference between the supply chain network of grocery and other products. The composition of the first order, where groceries items are low-value items but require a wide range of stock availability (fresh, frozen and processed). The average number of counts per bucket is 43 for a weekly grocery shop. The second is a specialist distribution network, where the network needs to meet requirements such as temperature for chilled/chilled items, short lead times and tight schedules at weekends. The third is that grocery e-retailing has a lower return rate.

Viu-Roig and Alvarez-Palau (2020) highlighted the issues raised by the retail revolution. One of the main issues is that the order size becomes small and the order frequency per week



Source(s): Li *et al.* (2008)

Figure 4. Q-commerce logistics network

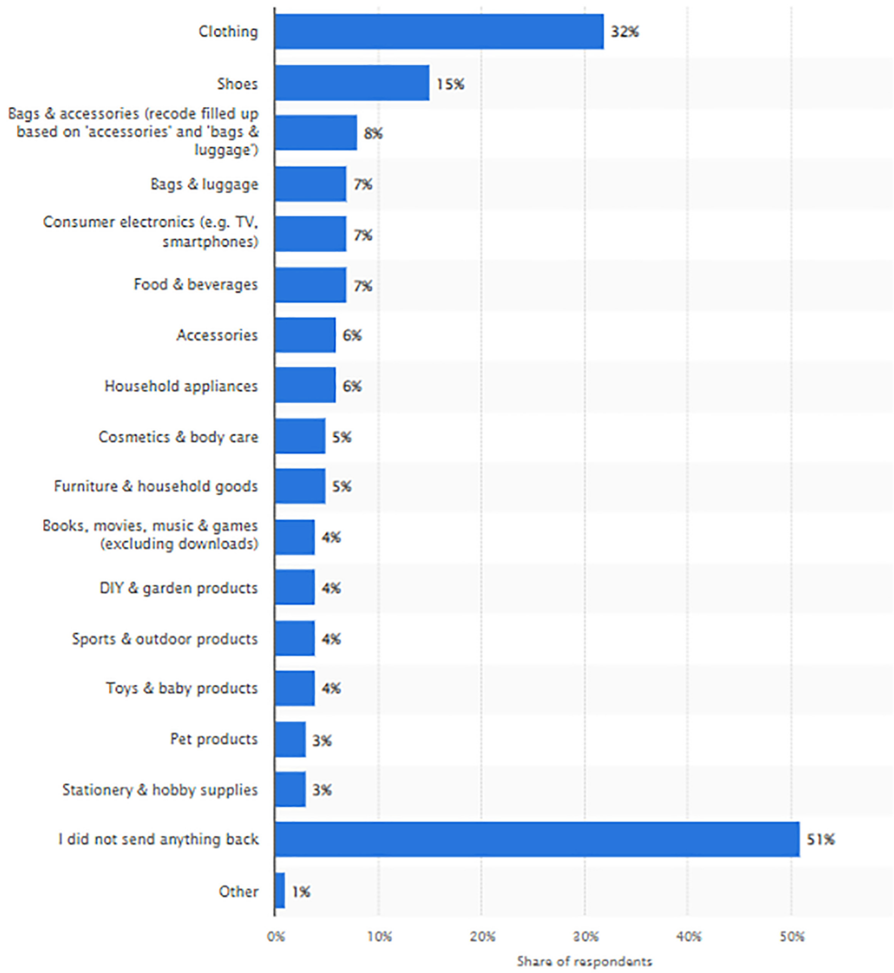
increases. E-retailer's system receives very frequent orders from different parts of the city with a tight delivery schedule. Bjerkan *et al.*'s (2020) study found that men in the 30–49 age group, of whom 88% are employed and 66% live in cities, are frequent E-commerce shoppers. Due to economic stability, stable employment and changing eating habits, this shopper tends to buy processed food with a shelf life of not more than four to five days. This leads to a reduction in the size of the shopping basket and the frequency of ordering twice a week. All this leads to a reduction in personal shopping trips and an increase in frequent trips by e-retailers. Joerss *et al.*'s (2016) research on 4,700 respondents suggests that almost a quarter of customers are willing to pay more for same-day delivery.

Product returns are a major issue for retailers, with serious implications for profitability and environmental sustainability goals (Urbanke *et al.*, 2015). Deges (2021) found that if the return rate is reduced by 10%, the profitability of the retailer increases by approximately 20%. Several studies (Fuchs, 2006; Maat and Konings, 2018) suggest that online shopping is more environmentally sustainable than B&M shopping if return rates are controlled by up to 10%. However, the aggregated return rates of E-commerce are between 20 and 25%, while B&M shops have only 8–10% returns. In some categories, such as clothing, where customers cannot experience the physical characteristics, e-retailers have high return rates of up to 40–45%. A recent online shopping returns survey by Kunst (2022) of 2,536 respondents in the UK is shown in Figure 5. The online grocery category has a return rate of 7%, which needs to be taken into account when calculating GHG emissions. Frei *et al.*'s (2022) research on UK's grocery e-retailers' returns problem shows a major reason. The top reason for returning a grocery item is that it was delivered damaged. The second is the wrong item delivered or the item listed on the website and the characteristics of the item delivered do not match. The third reason is customers changing their mind about accepting the product.

The issue of product returns is not as significant in Q-commerce as it is in E-commerce. Most Q-commerce orders placed by consumers are urgent and low-value items, and the 10–30-min delivery time does not give customers enough time to reconsider or change their mind.

Urbanke *et al.* (2015) suggest some ways to reduce the return rate. Restricting payment options, such as advance payment, restricts customers who are willing to return items. The cash-on-delivery option is still restricted for grocery shopping, as customers can easily refuse to accept some items. Technologies such as machine learning can easily detect high returnable items from a particular area and display low stock of these items to vulnerable customers. The system morally encourages customers to avoid returns on the checkout page by highlighting the environmental damage and carbon footprint of returns. Customers with zero returns in their last transaction should be rewarded with loyalty points and offers.

Xu *et al.* (2008) found that non-delivery due to not being at home at the time of delivery is the most critical factor for online delivery. Customers are not willing to wait for the product to be delivered due to changes in the patience level of new generations. It mostly depends on the value and size of the product. For high-value items (e.g. jewellery, watches and electronics), retailers have a policy of only physically delivering the package to the customer. In the case of low-value items such as clothing, if the customer is not at home, the parcel is delivered to a neighbour's house or to a secure location specified by the customer. According to a study by Heshmati *et al.* (2018), 68% of customers would prefer to buy more frequently from online stores if the retailer provided an alternative way to collect the missed delivery. In order to improve customer service, some retailers offer customers the option to redeliver the parcel a second time. Some retailers are constantly trying to work with local businesses, such as pharmacies and convenience stores, to leave undelivered parcels for customers to collect in order to provide greater convenience and improve customer service. UK grocery retailers are trying to reduce undelivered rates by reducing delivery charges when customers book



Source(s): Kunst (2022)

Figure 5. UK online shoppers' return rate

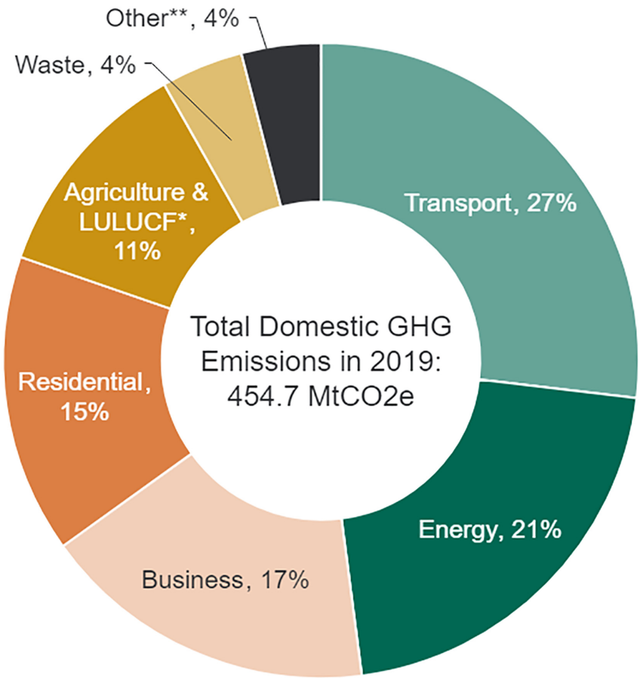
delivery slots and prefer off-peak times. Yu *et al.* (2016a) propose the concept of a data-integrated delivery system, in which a machine learning algorithm is trained according to successful delivery time slots from previous orders, and, for the delivery of the current order, the system designs the route so that most customers are available at home.

In the grocery delivery business, the barely earned profit by attracting customers, increasing their basket size, giving rewards/offers and arranging loyalty programmes is eaten up by frequent delivery of smaller parcels to customers' postcodes (Pahwa and Jaller, 2022). In such a complex environment, delivery failures and return order scenarios increase the retailer's operating costs and cause inconvenience to the customer. In both cases, the retailer's mileage for the initial trip from the local depot to the customer's home is wasted, and more mileage is required for the re-delivery/collection of the parcel, which ultimately increases GHG emissions in the last mile.

3.6 Environmental impact of logistics GHG emissions

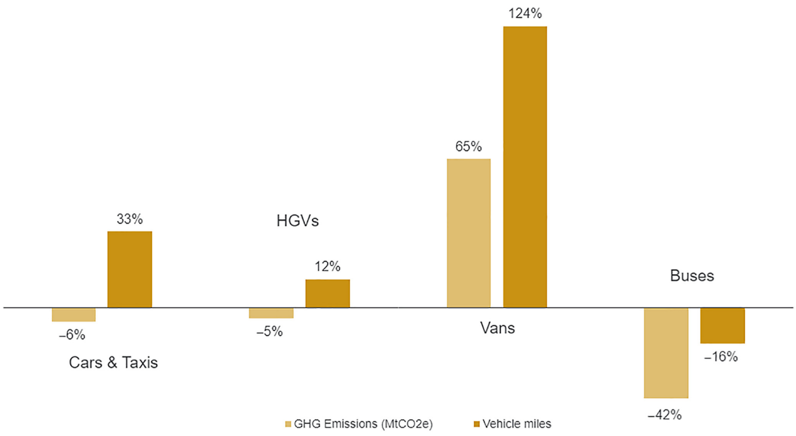
According to Ortolano and Shepherd (2017), environmental impact can be defined as "the disruption of life cycles across the Earth's operations, such as natural resources, environment, climate and meteorology". The Department for Transport (2021) report shows that the transport sector accounts for 27% of the UK's total emissions in 2019, as shown in Figure 6. After cars/taxis, heavy goods vehicles and vans account for 35% of the transport sector's emissions. The Department for Transport (2021) report highlights a reduction in emissions from vehicles from 1990 to 2019 due to stringent emission standards (EURO 5/6) and the development of more efficient engines, as shown in Figure 7. This graph shows that the mileage of lorries and vans has increased dramatically from 1990 to 2019, mainly due to the increase in e-shopping activities.

The potential difference between the evolution of retailing (B&M to Q-commerce) lies in how products are fulfilled and distributed. In e-retailing, retailers are responsible for logistics activities for home delivery, returns and issues of damaged and stolen items (Edwards *et al.*, 2010b). Siragusa and Tumino's (2021) study of the UK's top e-grocery retailers says that locating a distribution centre close to a large number of customers reduces transport lead time, reduces wasted miles driven for unachieved delivery, and reduces theft/damage in transit. Bertram and Chi's (2017) study results show that transportation, packaging, returns and disposal are the key factors that most influence GHG emissions in e-retailing. Various studies such as Carling *et al.* (2015), Wiese *et al.* (2012) and Jaller and Pahwa (2020) prove that E-commerce delivery is more environmentally friendly in terms of GHG emissions than traditional car shopping at B&M. The most influential factor in reducing emissions in last-mile delivery is the use of trucks/vans with consolidated parcel delivery instead of separate



Source(s): Department for Transport (2021)

Figure 6.
UK's domestic GHG emission



Source(s): Department for Transport (2021)

Figure 7. Change in milage and emission from 1990 to 2019

customer visits to B&M stores. Separate car trips to B&M stores release less GHG emissions only when the mileage is less than 4–5 miles. The result of their study also highlights that the GHG emissions induced by the last-mile delivery alone are greater than the energy used in the remaining transport operations of packaging, sorting/distribution and storage in facilities. Giuffrida *et al.*'s (2019) and Melacini and Tappia's (2018) study promotes the click-and-collect model of e-grocery shopping for environmental sustainability. In click and collect, the online order placed by the customer is prepared in the nearest store and the customer drives to collect the parcel. In this case, as the last-mile logistics activity is performed by the customer at their risk, damage and product return issues are reduced and the issue of missed delivery is eliminated. The need for more packaging in E-commerce is also marginal in click and collect, as the customer's car has enough space to properly pack the items. Shahmohammadi *et al.*'s (2020) study result on three models of grocery shopping is presented in Figure 8. This study included a full life cycle analysis including logistics, storage and packaging contribution to GHG emissions. The conclusion is identical to the above literature that last-mile logistics has the highest share in E-commerce shopping in the UK. E-commerce logistics need to be analysed so that logistics managers can work to optimise emissions.

3.7 Point of divergence

Various studies such as Mangiaracina *et al.* (2016) and Siragusa and Tumino (2021) where comparative analyses between B&M and E-commerce are conducted are based on points of divergence. Wiese *et al.* (2012) describe the point of divergence as the point up to which two segments are operationally indistinguishable. Today's food market is globalised and complex, with different products sourced from around the world and sold across all locations. Many fresh products such as bananas from Latin America, grapes from Chile/India, mangoes from the West African region and flowers from the North African region are sourced and sold in the UK (Office for National Statistics, 2022). Before reaching a central warehouse, retail goods are transported from different countries to the UK port and then by rail/road to a retailer's central facility. In the comparative study (van Loon *et al.*, 2015), the system boundaries between online and B&M were finalised and GHG emissions were only analysed in activities after the point of divergence. GHG emissions before the point of divergence were

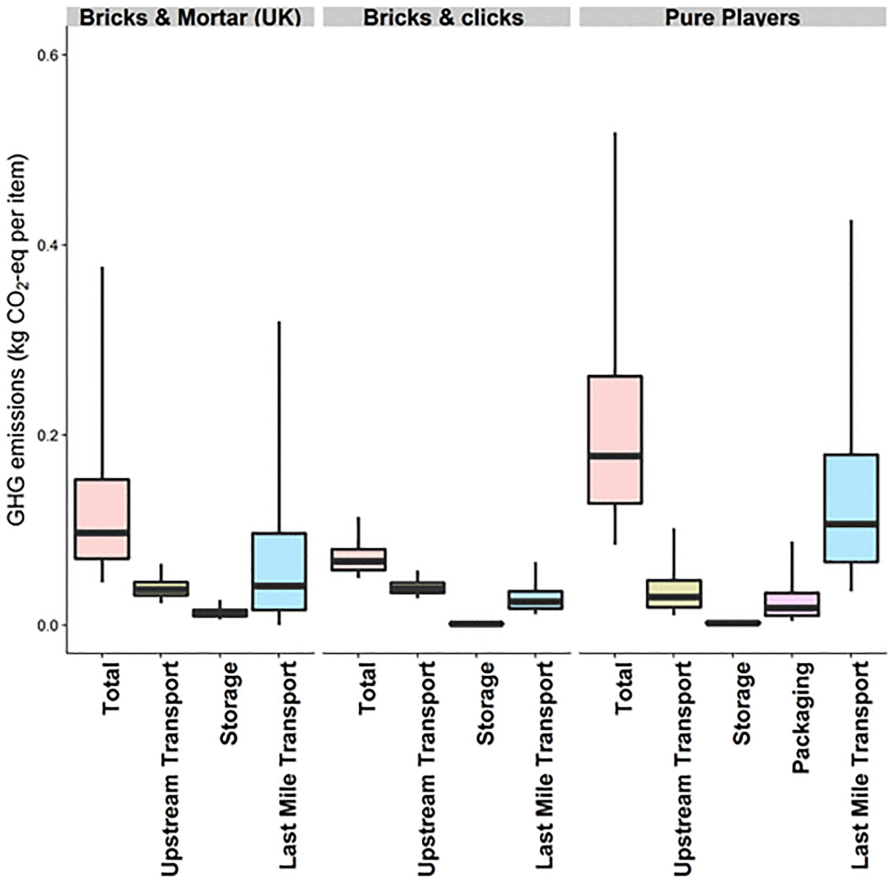


Figure 8.
GHG emission comparison of grocery shopping in the UK

Source(s): Shahmohammadi *et al.* (2020)

assumed to be the same as the same products from the same origin, available to B&M and E-commerce stores.

3.8 Parcel drop density and vehicle miles travelled (VMT)

Van Loon *et al.*'s (2015) study describes parcel drop density and VMT as a functional unit that varies last-mile emissions. Edwards *et al.* (2010a, b) highlight that in the UK, particularly in the grocery sector, parcel companies use pre-booked delivery slots to promote off-peak hours (11 am to 5 pm) by reducing delivery rates. This allows them to achieve significant volume, i.e. parcel density, in off-peak hours, which improves operational efficiency. For a given number of kilometres to be covered in one trip from the last-mile depot to many postcodes, a higher drop density divides the GHG emissions caused by one trip over many parcels, ultimately reducing the GHG emissions per parcel. Jaller and Pahwa's (2020) study resulted in drop density found in the triangular distribution of data in which minimum, maximum and average values are 15, 75 and 35 for an average 45-mile trip from the depot.

VMT is a term used in the last mile, which is the distance travelled after all parcels have been delivered by van/bike from the last-mile depot (Wygonik and Goodchild, 2018). In the case of pre-booked delivery times, if deliveries are distributed to every opposite location in the city in a given hour, VMT increases, which ultimately increases GHG emissions. Jaller and Pahwa (2020) concluded that online delivery reduces GHG emissions by an average of 46% compared to in-store visits, as VMT is reduced by 87.6%.

3.9 Population density

Feichtinger and Gronalt (2021) highlight the importance of customer location from a fulfilment centre. Customers located exactly in the same postcode as the fulfilment centre have less VMT than customers living at the outer limit of the last-mile service radius. They introduced the concept of the break-even point, which is defined as the point at which GHG emissions from online shopping are greater than those from in-store shopping. Environmentally conscious retailers therefore try to design logistics so that the vehicle does not operate beyond the break-even point. Their study calculated that the break-even point is 14 km from a local depot. As Q-commerce service promises to deliver products in less than 1 h, local fulfilment centres, called dark stores, are built in the central location of the area and have high potential customer density. Shahmohammadi *et al.* (2020) studied population density factors in three different tier 1 cities in the UK and used the average value of the distance from the fulfilment centre to the local hub.

4. Synthesis of findings and future research agenda

This section summarises the findings of the systematic review in order to understand the main conclusions extracted from the filtered literature.

4.1 Measuring environmental impact

In most of the research filtered in SLR (Systematic Literature Review), environmental impact is measured from four categories, namely upstream logistics, warehousing and storage facilities, last-mile logistics, and packaging and food waste. Upstream and last-mile logistics GHG emissions depend on the distance travelled by the vehicle, the mode of transport used and the vehicle's emission factor (kg CO2 eq/km). The last-mile GHG emission for electronics and casual goods shopping was calculated by assuming a return rate of around 25%. The methodology of van Loon *et al.* (2015) explains that the supply chain network of in-store shopping and E-commerce shopping, the packaging used, and the use of warehousing facilities are completely different. Therefore, the comparative study measures all of the above parameters. Wygonik and Goodchild's (2018) methodology used electricity consumption, gas consumption, consumption period, volume of goods and their GHG emission factors (kg CO2 eq/megajoule) to measure the impact of storage and warehousing facility. Shahmohammadi *et al.*'s (2020) study includes packaging factors such as GHG intensity of cardboard (kg CO2eq/g cardboard), GHG emission factor for packing paper (kg CO2eq/g kraft paper) and GHG emission factor of plastic bags (kg CO2eq/g plastic) and volume of plastic, cardboard and packing paper used. Finally, the total GHG emissions from retail activities are calculated by adding the emissions from all categories.

4.2 Factors considered in calculating GHG emission

Table 4 lists the factors that were considered when measuring GHG emissions in the SLR-filtered research. Life cycle analysis is the broader aspect of measuring GHG emissions from the starting point (warehouse) to the end point (customer's home). Almost all studies show

Table 4.
Key factors used for emission measurement

Factors Author	Basket size	Return rates	Failure deliveries	Packaging	Mode of transport	Facility energy usage	Population intensity	Delivery time and distance
Siragusa and Tumino (2021)	✔	✔	✔		✔	✔		✔
Wiese *et al.* (2012)		✔			✔		✔	✔
van Loon *et al.* (2015)	✔		✔					✔
Jaller and Pahwa (2020)		✔			✔		✔	✔
Carling *et al.* (2015)	✔		✔		✔			✔
Shahmohammadi *et al.* (2020)	✔		✔	✔	✔	✔	✔	✔
Schmitz (2020)	✔		✔		✔			✔
Edwards *et al.* (2010b)	✔	✔	✔	✔				✔
Briseño, 2021	✔		✔					✔
Zhao *et al.* (2019)	✔	✔		✔	✔		✔	✔
Buldeo Rai *et al.* (2019)		✔	✔					✔
Rosqvist and Hiselius (2016)	✔					✔	✔	✔
Seebauer *et al.* (2016)		✔	✔	✔			✔	✔

Source(s): Authors' own work

that last-mile delivery distance, delivery failure rates, basket size and last-mile transport mode are important factors in accessing GHG emissions.

4.3 Future research agenda

The Q-commerce business is currently in its early stages and has yet to penetrate tier 2 and 3 cities. Once the companies have achieved sufficient scale and scope, their logistics networks will be redesigned. This change needs to be analysed by business leaders in terms of GHG emissions in order to achieve net carbon neutrality. Our current research is limited to logistics activities in the supply chain. There is no such research in the Q-commerce segment that analyses GHG emissions from logistics as well as energy consumed by infrastructure used by the entities in the upstream and downstream supply chain. The GHG emissions from energy use can come from electricity used in warehouses, GHG emissions from plastics manufacturing processes and plastics recycling processes.

The results of this study describe the importance of each factor for calculating GHG emissions. For future studies, these factors can be calculated based on different thematic analyses according to the size and scope of the supply chain. This study found good quality of research such as Shahmohammadi *et al.* (2020) and Edwards *et al.* (2010b) which looked at GHG emissions for the E-commerce supply chain and counted emissions from factors such as logistics, packaging, electricity and water. The same type of calculation approach can be used to count the total GHG emissions of Q-commerce after its supply chain network has matured. This study does not highlight a proactive approach that organisations need to take to become carbon neutral. In future research, these proactive guidelines will help this new-age business that has less capital to invest in the segment of net carbon emissions. These proactive practices can be developed by analysing GHG emissions calculations at each step like upstream, last mile, storage or warehousing of the supply chain. In future studies, GHG emission calculations on different industries and case studies will help to make strategy for sustainability and attract customer attention.

Existing studies on GHG emissions lack a comprehensive analysis of how world-class companies have achieved or are strategising their supply chain to become net carbon neutral in the coming year. This comprehensive analysis will help small and medium enterprises to restructure their supply chain strategy, risk management, marketing, and awareness by adopting industry-specific trends. There is limited literature available in the form of case studies. There is therefore scope for future research. Countries are setting zero carbon targets to reduce the impact of global warming and climate change. Companies also need proper guidance to achieve this and reduce the financial impact.

5. Conclusion

The objective of this study is to bridge the existing literature gap by systematically classifying articles, summarising their primary themes, analysing the progression of published literature over time and offering guidance for future research that caters to the needs of both researchers and practitioners. By doing so, this study makes notable contributions to the Q-commerce and logistics literature. Firstly, it provides a comprehensive overview of key concepts, shedding light on the distinct features of Q-commerce and comparing it with E-commerce in terms of their GHG emissions. This comparative analysis enhances our understanding of the environmental impact of both forms of commerce. Secondly, the study emphasises the crucial factors for measuring GHG emissions in last-mile logistics within the realms of Q-commerce and E-commerce. By doing so, it contributes to scholars' comprehension of the evolving landscape of these emerging topics in the field. The findings of this study hold significant implications as they enable future research endeavours to tackle the inherent complexities associated with Q-commerce and last-mile logistics GHG emissions. Furthermore, they offer valuable insights into potential directions and areas of focus for future studies in this domain.

This systematic literature review shows the different methodologies used to measure GHG emissions from in-store and E-commerce, as Q-commerce is the latest trend in the modern way of buying groceries. This evolution in retailing was experimented worldwide during the COVID-19 pandemic, when B&M stores are closed, and E-commerce services took at least a day to deliver groceries due to the surge in demand. The Q-commerce service is available in limited locations around the world such as London, Manchester, Bangalore, California, New York, San Francisco, etc. The area of Q-commerce has yet to be thoroughly explored by researchers and as a result very little research has been conducted in this category. The environmental impact of this shopping category is still at an early stage of assessment. Additionally, it is important to acknowledge the other limitations of this study. One limitation is the use of limited sources for identifying articles, which could result in relevant articles from other reputable publications being overlooked if they fell outside the predefined research boundaries. Furthermore, by filtering articles based on their publication dates, focusing on those published between 2016 and 2022, there is a possibility of excluding older seminal papers that are frequently cited but may lie outside our search parameters. This exclusion could impact the overall discussion and analysis.

The following key parameters were identified in this study of Q-commerce that are important for controlling GHG emissions:

1. Environmental impact due to speed of delivery
2. Market suitability of the model
3. Order patterns by season, geography
4. Logistics challenges
5. Return rates and failed delivery attempts
6. Technological advancements such as warehouse automation, drones and electric bike network for delivery, etc.

The main findings of this study on literature review are

1. A lack of literature review on Q-commerce within the supply chain framework.
2. Q-commerce is an emerging business, and its supply chain is not yet optimised.
3. Less studied issues in the supply chain of Q-commerce, which include carbon emissions, emission control and decarbonisation.

Although the current studies focus on different topics and research objectives, there is still room for further research. Our study can serve as a trusted resource for sustainability managers and practitioners concerned with reducing carbon emissions to achieve the net zero goal. Future research will be able to take advantage of the study's openings and gain a better understanding of the thematic and scientific context in this area. Despite the increase in studies, net zero and supply chain decarbonisation remain relevant and rich topics that require further investigation and study in the future. Also, proactive practices can be developed by analysing GHG emissions at each step of the supply chain, including upstream processes, last-mile delivery, and storage or warehousing. Additionally, future studies examining GHG emissions in different industries and case studies will help formulate sustainability strategies and attract customer attention. This systematic review, in our opinion, will aid researchers and practitioners in understanding the thematic and scientific context of the subject, as well as research themes and their relationships, significant expressions, and potential directions for further study.

References

Bertram, R.F. and Chi, T. (2017), "A study of companies' business responses to fashion e-commerce's environmental impact", *International Journal of Fashion Design, Technology and Education*, Vol. 11 No. 2, pp. 254-264, doi: 10.1080/17543266.2017.1406541.

Bjerkan, K.Y., Bjørgen, A. and Hjelkrem, O.A. (2020), "E-commerce and prevalence of last mile practices", *Transportation Research Procedia*, Vol. 46, pp. 293-300, doi: 10.1016/j.trpro.2020.03.193.

Bogdanova, M. (2021), "Quick commerce in Western Europe: trends, operational models. . .. [online]", Euromonitor, available at: https://www.euromonitor.com/article/quick-commerce-in-western-europe-trends-operational-models-and-prospects

Bommireddipalli, R.T. (2022), "Council post: what's next for Q-commerce: the golden child of E-commerce", Forbes, available at: https://www.forbes.com/sites/forbestechcouncil/2022/02/08/whats-next-for-q-commerce-the-golden-child-of-e-commerce/?sh=d1690d144436 (accessed 19 May 2022).

Briseño, D. (2021), *Retail Carbon Footprints: Measuring Impacts from Real Estate and Technology*, MIT Real Estate Innovation Lab, pp. 1-9.

Buldeo Rai, H., Mommens, K., Verlinde, S. and Macharis, C. (2019), "How does consumers' omnichannel shopping behaviour translate into travel and transport impacts? Case-study of a footwear retailer in Belgium", *Sustainability*, Vol. 11 No. 9, pp. 25-34, doi: 10.3390/su11092534.

Carling, K., Han, M., Håkansson, J., Meng, X. and Rudholm, N. (2015), "Measuring transport related CO2 emissions induced by online and brick-and-mortar retailing", *Transportation Research Part D: Transport and Environment*, Vol. 40, pp. 28-42, doi: 10.1016/j.trd.2015.07.010.

Chevalier, S. (2022), "UK: quick commerce market size 2021", Statista, available at: https://www.statista.com/statistics/888178/market-size-quick-commerce-uk/#:~:text=Based%20on%20the%20claimed%20spend

Chopra, S. (2019), *Supply Chain Management: Strategy, Planning and Operation*, 7th ed., Pearson Education, New York, Ny.

Clark, D. (2022), "UK transport GVA 2021", Statista, available at: https://www.statista.com/statistics/760118/transport-and-storage-sector-gross-value-added-in-the-uk/

Coppola, D. (2022), "B2B and B2C e-commerce sales via website UK 2018", Statista, available at: https://www.statista.com/statistics/284278/e-commerce-sales-via-website-in-the-united-kingdom-uk-by-b2b-and-b2c/

Deges, F. (2021), "Retourencontrolling im online-Handel", *Controlling*, Vol. 33 No. 2, pp. 61-68, doi: 10.15358/0935-0381-2021-2-61.

Department for Transport. (2021), "Transport and environment statistics: Autumn 2021", [online] GOV.UK, available at: https://www.gov.uk/government/statistics/transport-and-environment-statistics-autumn-2021/transport-and-environment-statistics-autumn-2021

Edwards, J., McKinnon, A., Cherrett, T., McLeod, F. and Song, L. (2010a), "Carbon dioxide benefits of using collection–delivery points for failed home deliveries in the United Kingdom", *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2191 No. 1, pp. 136-143, doi: 10.3141/2191-17.

Edwards, J.B., McKinnon, A.C. and Cullinane, S.L. (2010b), "Comparative analysis of the carbon footprints of conventional and online retailing", *International Journal of Physical Distribution and Logistics Management*, Vol. 40 Nos 1/2, pp. 103-123, doi: 10.1108/09600031011018055.

Feichtinger, S. and Gronalt, M. (2021), "The environmental impact of transport activities for online and in-store shopping: a systematic literature review to identify relevant factors for quantitative assessments", *Sustainability*, Vol. 13 No. 5, pp. 29-81, doi: 10.3390/su13052981.

Fisher, M.L. (1997), "What is the right supply chain for your product?", Harvard Business Review, Harvard, Boston, MA.

Frei, R., Jack, L. and Sally-Ann, K. (2022), "Mapping product returns processes in multichannel retailing: challenges and opportunities", *Sustainability*, Vol. 14 No. 3, p. 1382, doi: 10.3390/su14031382.

Fuchs, C. (2006), "The implications of new information and communication technologies for sustainability", *Environment, Development and Sustainability*, Vol. 10 No. 3, pp. 291-309, doi: 10.1007/s10668-006-9065-0.

Giuffrida, M., Tumino, A., Miragliotta, G., Perotti, S. and Mangiaracina, R. (2019), "Modelling the environmental impact of omni-channel purchasing in the apparel industry: the role of logistics", *International Journal of Logistics Systems and Management*, Vol. 34 No. 4, p. 431, doi: 10.1504/ijlsm.2019.10025130.

Heshmati, S., Verstichel, J., Esprit, E. and Berghe, G.V. (2018), "Alternative ecommerce delivery policies A case study concerning the effects on carbon emission", *EURO Journal on Transportation and Logistics*, Vol. 8 No. 3, pp. 217-248.

IBM (2020), "Meet the 2020 consumers driving change", pp. 1-5, IBM, available at: https://www.ibm.com/downloads/cas/EXK4XKX8

Jaller, M. and Pahwa, A. (2020), "Evaluating the environmental impacts of online shopping: a behavioral and transportation approach", *Transportation Research Part D: Transport and Environment*, Vol. 80, p. 10, doi: 10.1016/j.trd.2020.102223.

Jewels, T.J. and Timbrell, G.T. (2001), "Towards a definition of B2C & B2B e-commerce", *Australasian Conference on Information Systems*, Vol. 56 No. 12, pp. 3-7, available at: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1035&context=acis2001

Joerss, M., Neuhaus, F. and Schröder, J. (2016), "How customer demands are reshaping last-mile delivery", Travel, Transport & Logistics: McKinsey & Company, p. 3, available at: https://www.mckinsey.com/~/media/McKinsey/Industries/Travel%20Logistics%20and%20Infrastructure/Our%20Insights/How%20customer%20demands%20are%20reshaping%20last%20mile%20delivery/How-customer-demands-are-reshaping-last-mile-delivery.pdf

Kitchenham, B. (2004), *Procedures for Performing Systematic Reviews*, Keele University, Keele, Vol. 33, pp. 1-26.

Kunst, A. (2022), "Returns of online purchases by category in the UK 2020", Statista, available at: https://www.statista.com/forecasts/997848/returns-of-online-purchases-by-category-in-the-uk

Li, H., Zhang, Y. and Wu, J. (2008), "The future of e-Commerce logistics", *IEEE Service Operations and Logistics, and Informatics*, Vol. 1.

Maat, K. and Konings, R. (2018), "Accessibility or innovation? Store shopping trips versus online shopping", *Transportation Research Record: Journal of the Transportation Research Board*, Vol. 2672 No. 50, pp. 1-10, doi: 10.1177/0361198118794044.

Mangiaracina, R., Marchet, G., Perotti, S. and Tumino, A. (2015), "A review of the environmental implications of B2C e-commerce: a logistics perspective", *International Journal of Physical Distribution and Logistics Management*, Vol. 45 No. 6, pp. 565-591, doi: 10.1108/ijpdlm-06-2014-0133.

Mangiaracina, R., Perego, A., Perotti, S. and Tumino, A. (2016), "Assessing the environmental impact of logistics in online and offline B2C purchasing processes in the apparel industry", *International Journal of Logistics Systems and Management*, Vol. 23 No. 1, p. 98, doi: 10.1504/ijlsm.2016.073300.

Melacini, M. and Tappia, E. (2018), "A critical comparison of alternative distribution configurations in omni-channel retailing in terms of cost and greenhouse gas emissions", *Sustainability*, Vol. 10 No. 2, p. 307, doi: 10.3390/su10020307.

Office for national Statistics (2022), "Trade in goods: country-by-commodity imports - office for national Statistics", available at: https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/datasets/uktradecountrybycommodityimports

Ortolano, L. and Shepherd, A. (2017), "Environmental impact assessment: challenges and opportunities", *Impact Assessment*, Vol. 13 No. 1, pp. 3-30, doi: 10.1080/07349165.1995.9726076.

Pahwa, A. and Jaller, M. (2022), "A cost-based comparative analysis of different last-mile strategies for e-commerce delivery", *Transportation Research Part E: Logistics and Transportation Review*, Vol. 164, 102783, doi: 10.1016/j.tre.2022.102783.

Pi, S. and Wang, Y. (2020), "An E-tailer's operational strategy under different supply chain structures", *Sustainability*, Vol. 12 No. 5, pp. 21-41, doi: 10.3390/su12052141.

Rosqvist, L.S. and Hiselius, L.W. (2016), "Online shopping habits and the potential for reductions in carbon dioxide emissions from passenger transport", *Journal of Cleaner Production*, Vol. 131, pp. 163-169, doi: 10.1016/j.jclepro.2016.05.054.

Salter, A., Salandra, R. and Walker, J. (2017), "Exploring preferences for impact versus publications among UK business and management academics", *Research Policy*, Vol. 46 No. 10, pp. 1769-1782.

Schmitz, T. (2020), "Critical analysis of carbon dioxide emissions in a comparison of e-commerce and traditional retail", *Journal of Applied Leadership and Management*, Vol. 8, pp. 72-89.

Seebauer, S., Kulmer, V., Bruckner, M. and Winkler, E. (2016), "Carbon emissions of retail channels: the limits of available policy instruments to achieve absolute reductions", *Journal of Cleaner Production*, Vol. 132, pp. 192-203, doi: 10.1016/j.jclepro.2015.02.028.

Shahmohammadi, S., Steinmann, Z.J.N., Tambjerg, L., van Loon, P., King, J.M.H. and Huijbregts, M.A.J. (2020), "Comparative greenhouse gas footprinting of online versus traditional shopping for fast-moving consumer goods: a stochastic approach", *Environmental Science and Technology*, Vol. 54 No. 6, pp. 3499-3509, doi: 10.1021/acs.est.9b06252.

Siragusa, C. and Tumino, A. (2021), "E-grocery: comparing the environmental impacts of the online and offline purchasing processes", *International Journal of Logistics Research and Applications*, Vol. 25, pp. 1164-1190.

Sydney, E.B., Letti, L.A.J., Karp, S.G., Sydney, A.C.N., Vandenberghe, L.P. de S., de Carvalho, J.C., Woiciechowski, A.L., Medeiros, A.B.P., Soccol, V.T. and Soccol, C.R. (2019), Current Analysis and Future Perspective of Reduction in Worldwide Greenhouse Gases Emissions by Using First and Second Generation Bioethanol in the Transportation Sector, *Bioresource Technology Reports, [online]*, Vol. 7, 100234, doi: 10.1016/j.biteb.2019.100234.

Tehrani, S.M. (2005), "Application of e-commerce in local home shopping and its consequences on energy consumption and air pollution reduction", *Iranian Journal of Environmental Health Science and Engineering*, Vol. 2, pp. 247-250.

Urbanke, P., Kranz, J. and Kolbe, L. (2015), "Predicting Product Returns in E-Commerce: The Contribution of Mahalanobis Feature Extraction", *Thirty Sixth International Conference on Information Systems*.

van Loon, P., Deketele, L., Dewaele, J., McKinnon, A. and Rutherford, C. (2015), "A comparative analysis of carbon emissions from online retailing of fast moving consumer goods", *Journal of Cleaner Production*, Vol. 106, pp. 478-486, doi: 10.1016/j.jclepro.2014.06.060.

Viu-Roig, M. and Alvarez-Palau, E.J. (2020), "The impact of E-commerce-related last-mile logistics on cities: a systematic literature review", *Sustainability*, Vol. 12 No. 16, pp. 64-92, doi: 10.3390/su12166492.

Wiese, A., Toporowski, W. and Zielke, S. (2012), "Transport-related CO2 effects of online and brick-and-mortar shopping: a comparison and sensitivity analysis of clothing retailing", *Transportation Research Part D: Transport and Environment*, Vol. 17 No. 6, pp. 473-477, doi: 10.1016/j.trd.2012.05.007.

Wygonik, E. and Goodchild, A. (2012), "Evaluating the efficacy of shared-use vehicles for reducing greenhouse gas emissions: a U.S. Case study of grocery delivery", *Journal of the Transportation Research Forum*, Vol. 51 No. 2, pp. 3-9, doi: 10.5399/osu/jtrf.51.2.2926.

Wygonik, E. and Goodchild, A.V. (2018), "Urban form and last-mile goods movement: factors affecting vehicle miles travelled and emissions", *Transportation Research Part D: Transport and Environment*, Vol. 61, pp. 217-229, doi: 10.1016/j.trd.2016.09.015.

Xu, M., Ferrand, B. and Roberts, M. (2008), "The last mile of e-commerce – unattended delivery from the consumers and eTailers' perspectives", *International Journal of Electronic Marketing and Retailing*, Vol. 2 No. 1, p. 20, doi: 10.1504/ijemr.2008.016815.

Younes, H., Noland, R.B. and Zhang, W. (2022), "Browsing for food: will COVID-induced online grocery delivery persist?", *Regional Science Policy and Practice*. doi: 10.1111/rsp3.12542.

Yu, Y., Tang, J., Li, J., Sun, W. and Wang, J. (2016a), "Reducing carbon emission of pickup and delivery using integrated scheduling", *Transportation Research Part D: Transport and Environment*, Vol. 47, pp. 237-250, doi: 10.1016/j.trd.2016.05.011.

Yu, Y., Wang, X., Zhong, R.Y. and Huang, G.Q. (2016b), "E-Commerce logistics in supply chain management: practice perspective", *Procedia CIRP*, Vol. 52, pp. 179-185, doi: 10.1016/j.procir.2016.08.002.

Zhao, Y.-B., Wu, G.-Z., Gong, Y.-X., Yang, M.-Z. and Ni, H.-G. (2019), "Environmental benefits of electronic commerce over the conventional retail trade? A case study in Shenzhen, China", *The Science of the Total Environment*, Vol. 679, pp. 378-386, doi: 10.1016/j.scitotenv.2019.05.081.

Further reading

Allen, J., Piecyk, M., Piotrowska, M., McLeod, F., Cherrett, T., Ghali, K., Nguyen, T., Bektas, T., Bates, O., Friday, A., Wise, S. and Austwick, M. (2018), "Understanding the impact of E-commerce on last-mile light goods vehicle activity in urban areas: the case of London", *Transportation Research Part D: Transport and Environment*, Vol. 61, pp. 325-338, doi: 10.1016/j.trd.2017.07.020.

Azadeh, K., de Koster, M.B.M. and Roy, D. (2017), "Robotized warehouse systems: developments and research opportunities", *SSRN Electronic Journal*. doi: 10.2139/ssrn.2977779.

Bonate, P.L. (2001), "A brief introduction to Monte Carlo simulation", *Clinical Pharmacokinetics*, Vol. 40 No. 1, pp. 15-22, doi: 10.2165/00003088-200140010-00002.

Boysen, N., Briskorn, D., Fedtke, S. and Schwerdfeger, S. (2018), "Drone delivery from trucks: drone scheduling for given truck routes", *Networks*, Vol. 72 No. 4, pp. 506-527, doi: 10.1002/net.21847.

Dimoula, V., Kehagia, F., Tsakalidis, A. and Tengir, P. (2017), "A holistic approach for estimating carbon emissions of road and rail transport systems", *Aerosol and Air Quality Research*, Vol. 16 No. 1, pp. 61-68, doi: 10.4209/aaqr.2015.05.0313.

DPD (2018), "Parcel delivery network of corporate social responsibility report 2018 2 3 content", available at: https://www.dpd.co.uk/content/about_dpd/DPDgroup_CSR_report_2018_EN_VF.pdf

Ganesha, H.R. and Aithal, S. (2020), "Consumer affordability in tier-1, tier-2 and tier-3 cities of India - an empirical study", *International Journal of Applied Engineering and Management Letters (IJAEML)*, Vol. 4 No. 1, pp. 156-171, doi: 10.5281/zenodo.3822509.

Heard, B.R., Bandekar, M., Vassar, B. and Miller, S.A. (2019), "Comparison of life cycle environmental impacts from meal kits and grocery store meals", *Resources, Conservation and Recycling*, Vol. 147, pp. 189-200, doi: 10.1016/j.resconrec.2019.04.008.

Hermes (2016), "Hermes report", available at: https://www.hermesworld.com/remote/content/verantwortung-neu/downloads/hermes-sustainability-report-1.pdf

Kaushik, A. (2022), "Conversion of petrol bike to an electric bike", *International Journal of Innovative Research in Engineering and Multidisciplinary Physical Sciences*, Vol. 10 No. 2, doi: 10.37082/ijirmps.2022.v10i02.011.

Metapack (2022), "Ecommerce delivery management software", Metapack, available at: https://info.metapack.com/rs/700-ZMT-762/images/Ecommerce%20Delivery%20Benchmark%20Report%202022%20%282%29.pdf

Nast, C. (2020), "Ocado's robot future has one major flaw: cheap, squishy humans", Wired UK, available at: https://www.wired.co.uk/article/ocado-robot-wars

RG, A. (2022), "How to reduce ecommerce return rates: statistics and best practices - richpanel", available at: https://www.richpanel.com/blog/ecommerce-return-rates

About the authors

Harshal Pandurang Gund has completed Bachelor's in Mechanical Engineering at Pune University. He moved to the United Kingdom for studying master's degree in Global Operations and Supply Chain Management at the University of Derby. He received the the GREAT scholarship funded by the British Council to study at the University of Derby. During his master's degree, he worked as an intern in an E-commerce company and studied different models of e-commerce supply chains. His logistics optimization model helped the company to improve OTIF by 2.3% and reduce online return by 1.2%. Currently, he is working in the automobile sector for improving logistics efficiency.

Dr Jay Daniel is Program Leader for MSc Global Operations and Supply Chain Management and Senior Lecturer at the University of Derby. Before joining the Derby Business School, he was Lecturer (Assistant Professor) in Supply Chain and Information Systems at the University of Technology Sydney (UTS), Australia. Previously with DB Schenker, Australia, and Alliance International Registrar, Asia Pacific, he held positions of Senior Management Consultant, Supply Chain Solution Analyst, Project Manager, Industry Trainer and Lead Auditor. He holds a Ph.D. in Industrial and Systems Engineering/Supply Chain from UPM. Dr Daniel published over 50 papers in journals and international conferences such as *IEEE Transactions on Fuzzy Systems, International Journal of Information Management, Service Research and Innovation*, etc. His primary areas of research focus are supply chain management and business analytics, information systems and sustainable supply chain, blockchain and Industry 4.0 (artificial intelligence) and healthcare supply chain management. His research is funded by government agencies and industry collaborators around the World. Dr Daniel has been invited as a keynote speaker/invited speaker at international industry and academic workshops and conferences around the globe such as Keynote Speaker in Oracle Modern Business Experience Conference (Australia) and Worldclass speaking about sustainable supply chain at IISRP (Global). Jay Daniel can be contacted at: j.daniel@derby.ac.uk

For instructions on how to order reprints of this article, please visit our website:
www.emeraldgrouppublishing.com/licensing/reprints.htm
Or contact us for further details: **permissions@emeraldinsight.com**