Digital Transformation in Retail Logistics: Analysis of Mercadona and Carrefour in Last-Mile Delivery.

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Abstract

This thesis analyses how large grocery retailers implement digital transformation strategies to address inefficiencies and complexities in last-mile delivery. Through a qualitative multiple-case study of Mercadona and Carrefour, two leading supermarkets in the Spanish industry, and using secondary data from corporate documents, industry reports, and academic literature, the study identifies key technological innovations shaping last-mile operations.

Digital transformation in grocery logistics is driven by technologies such as AI-based routing, automated fulfilment, data analytics, and digital delivery platforms, which help address inefficiencies and complexities related to cost, routing inefficiencies, perishability, and multi-actor coordination. Using the frameworks of Organising for Innovation, and concretely with the approaches of open and closed innovation, and Sources of Innovation, using the technology-push and need-pull categorisation, the thesis categorises each innovation based on the researcher's interpretation and examines how organisational and strategic choices influence its implementation.

Findings show that Mercadona follows a more closed and centralised coupling model of innovation, whereas Carrefour adopts an open, decentralised, and also coupling model of innovation. These differences and convergences shape their capacity address the inefficiencies and complexities in last mile delivery.

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1. Introduction

1.1. Background and context

In today's world, new technologies are always being developed and changing the way that tasks are conducted, both in daily life and in business. For companies, remaining competitive requires not only adapting to these changes but also engaging in processes of digital transformation. One of the impacted industries is the retail sector, which will be the subject of this thesis since it is under pressure to innovate to satisfy changing consumer demands and market conditions.

This concept of digital transformation has become one of the most important and difficult aspects of retail logistics, particularly in the grocery industry, with a focus on last-mile delivery. The emergence of e-commerce and omnichannel retailing has increased consumer expectations for fast, reliable, and flexible deliveries, while simultaneously adding complexity to supply chain operations (Mangiaracina et al., 2019). In addition to being the most visible part of the logistics process for consumers, the last mile is usually the most costly and inefficient part of the logistics process, often accounting for more than half of the overall delivery costs (Mangiaracina et al., 2019). According to research, the last mile is the costliest component in the supply chain, contributing up to 53% of overall logistics expenses (Boysen et al., 2021). Retailers should therefore make it a priority to explore and apply innovations that can improve efficiency while satisfying consumer demands (Mangiaracina et al., 2019).

Several strategies have been developed to address last-mile challenges, ranging from parcel lockers and pick-up points to crowdsourced delivery, autonomous vehicles, and the establishment of micro-fulfilment centres (Mangiaracina et al., 2019; Engesser et al., 2023). These digital and technological innovations could reduce costs as well as, enhance delivery reliability, and sustainability.

The issues of last-mile delivery impact the entire retail industry, but because of product attributes, frequency of purchases, and profit margins, the researcher presumed that these issues could be especially important in grocery retail. Compared to non-food retail, supermarkets deal with perishable goods, temperature-controlled logistics, and tight delivery windows, which are assumed to make last-mile operations complicated and expensive. Additionally, the customer tolerance for failed or delayed delivery is low in the retail sector, which could impact significantly the grocery industry due to the nature of the goods (Mangiaracina et al., 2019; Ieva et al., 2025). Viu-Roig and Álvarez-Palau (2020) also emphasise that urban grocery delivery adds pressure on city infrastructure because orders are smaller, more frequent, and time-sensitive.

To conclude, companies in the retail industry would benefit from a digital transformation in order to stay competitive. Grocery retailers, as part of the retail industry, are presumed to work with narrow margins and small flexibility, making technological innovation in last-mile essential. Technologies such as warehouse automation, AI-driven routing, parcel lockers, and autonomous delivery systems can be implemented to solve urgent logistical challenges. However, research is still being done on their effectiveness, scalability, and broader implications for retailers and cities.

1.2. Problem statement

Despite the growing digital transformation in last-mile delivery, significant challenges remain unsolved. The last mile continues to be one of the parts of the supply chain that need the most resources, combining high operational costs, low efficiency, and increasing customer expectations for convenience and sustainability (Mangiaracina et al., 2019; Viu-Roig & Álvarez-Palau, 2020). While innovative solutions such as micro-fulfilment centres or autonomous vehicles promise improvements, their implementation requires substantial investments and organisational adaptation consequently, it is reasonable to consider that their long-term viability in the supermarket industry remains uncertain (Engesser et al., 2023).

These broad challenges manifest in multiple forms, ranging from environmental and infrastructural to technological and organisational, but from an operational perspective, many of them translate in two fundamental dimensions: inefficiencies and complexities. Inefficiencies refer to the excessive time, cost, or resource consumption in last-mile processes, whereas complexities arise from the interdependence of actors, technologies, and fulfilment models involved in grocery delivery. These two dimensions are particularly relevant for grocery retailers, as they capture the underlying mechanisms that make last-mile operations costly, difficult to scale, and strategically critical.

This context creates a problem that is both operational and strategic: How can large grocery retailers implement digital transformation strategies, through technological innovations, that address the inefficiencies and complexities in last-mile delivery? By focusing on these two core dimensions, this thesis narrows the analysis from the broader set of challenges commonly identified in last-mile logistics to the specific operational and organisational factors that most directly affect performance and innovation outcomes.

By formulating the problem in this way, this thesis situates itself at the intersection of last-mile, innovation management, and digital transformation. It seeks to provide evidence and insights into how two leading European retailers, Carrefour and Mercadona, address these inefficiencies and complexities within the Spanish market.

1.3. Research Objectives and Questions

The objective of this thesis is to examine how Mercadona and Carrefour implement digital transformation strategies, through technological innovations within their last-mile delivery processes. Building on the approaches of Organising and Sourcing for Innovation, the study aims to explore the companies structure, approaches and sources for these innovations.

The research therefore has three different goals. First, to identify the technological innovations implemented by Mercadona and Carrefour within the last-mile delivery. Second, to classify the innovations according to the source, whether they emerge from operational or market needs, **need-pull**, or from technological possibilities, **technology-push**. By distinguishing between these two drivers, the research seeks to identify the motivations behind the innovations, and whether they are reactive to demand or proactive in leveraging technological opportunities.

Lastly, it aims to analyse how these innovations are organised, distinguishing whether they are developed internally, **closed**, or through external partners/actors, **open**. Examining this dimension will provide insights into how organisational structures and strategies shape the adoption and implementation of digital technologies in last mile. With this, the thesis aims to shed light not only on what these companies are doing in last mile transformation but also why these innovations emerge and how they are structurally implemented.

This research addresses a critical problem in the supermarket sector: last-mile delivery. This represents some of the most complex and costly stages of the supply chain. By providing empirical evidence and analysis, this study seeks to offer a lens through which retailers can investigate new digital transformation strategies to address inefficiencies and complexities in this crucial part of the logistics process.

To address the general research question: *"How can large grocery retailers implement digital transformation strategies, through technological innovations, that address the inefficiencies and complexities in last-mile delivery?"*, this thesis will explore two complementary sub-questions:

"What technological innovations within last-mile delivery have Mercadona and Carrefour implemented to address the inefficiencies and complexities?"

and

"How do the organising and sourcing approaches to innovation influence the way these technological innovations address inefficiencies and complexities in last-mile delivery?"

These research questions are designed to be complementary and collectively address the overarching aim of the thesis. The first sub-question identifies and describes the technological innovations implemented by Mercadona and Carrefour within last-mile delivery to address the inefficiencies and complexities in this stage of the logistic chain, revealing how digital transformation is operationalised in practice. The second sub-question takes a more analytical perspective, examining how the sources of innovation (need-pull or technology-push) and the organisational approaches adopted (open or closed) influence the extent to which these innovations address the inefficiencies and complexities outlined in the general research question. Together, they enable the study of not only what innovations exist, but also the why and how certain innovations, depending on their origin and organisational model, can help overcome operational inefficiencies and manage logistical complexities in the grocery retail sector.

Both approaches, Sources of Innovation (need-pull vs technology-push) and Organising for Innovation (open vs closed), will not be applied as abstract concepts, but as analytical lenses to explain why the identified innovations exist and how they are structured. Each innovation observed in Mercadona and Carrefour will therefore be linked to the specific inefficiencies and complexities of the last mile. By categorising each innovation according to its source (need-pull or technology-push) and its organisational approach (open or closed), the thesis will be able to interpret whether a certain innovation is reactive to market demands, or enabled by technological opportunities, and whether it is internally developed or introduced through external partners. This allows the analysis to go beyond description: it links innovation logic and organisational structure directly to the extent in which the innovations address the inefficiencies and complexities of last-mile delivery. The findings are expected to offer practical and theoretical insights for other retailers navigating the challenges of digital transformation in a highly competitive and rapidly evolving sector.

1.4. The case studies

Mercadona and Carrefour, the selected case studies, are leading supermarket chains in Spain and France, respectively, each with substantial domestic market presence. Carrefour also operates extensively across Europe and exerts significant influence in the Spanish market, which will be the one studied in this thesis. This chapter presents both companies and their digital transformation strategies.

1.4.1. Mercadona

This thesis examines **Mercadona**, a prominent Spanish supermarket chain whose strategic objective is to lead digital transformation within Spain's grocery sector.

Founded in 1977 by the *Cárnicas Roig* group, originally a butcher shop, Mercadona is a family-owned company and one of the most important physical and online supermarket chains in Spain. Its mission is to take full responsibility for recommending to *"El Jefe"* (the customer) the best possible options to meet their needs in food, household care, personal care, and pet care while always ensuring uncompromising quality, maximum service, minimum cost, and minimal time investment. As a result, 5.9 million households place their trust in the company every day. Today, Mercadona operates 1,603 stores in Spain and 63 in Portugal, employing a workforce of 110,000 people. Since 1993, all of Mercadona's strategic decisions have been based on its Total Quality Model, which seeks to satisfy equally and with the same intensity the five core stakeholders of the company: the customer, employees, suppliers, society, and capital. (Mercadona, s. f.)

Mercadona has consistently invested in technology to stay ahead of the competition and drive digital transformation. In 1982, it became the first company in Spain to use barcode scanners at points of sale (Mercadona, s.f.). Concretely, for last-mile delivery, the initiatives include the transformation of online operations through dedicated "colmenas" (micro-fulfilment centres) that allow to deliver faster for e-commerce sales, the redesign of its e-commerce platform, where customers can purchase and return items, and the use of artificial intelligence and advanced analytics to improve stock management, routing, and customer service (Mercadona, s.f.).

Mercadona represents a relevant case for examining how large grocery retailers in Spain are approaching the digital transformation of last-mile delivery. As one of the country's leading supermarket chains, its scale, operational model, and investment in technological innovation offer valuable insights into how digital tools are reshaping logistics and service delivery in the grocery sector.

1.4.2. Carrefour

Carrefour is one of the largest retail groups in Europe and a pioneer in the development of digital strategies for grocery distribution. Founded in 1959 in Annecy, France, Carrefour expanded rapidly through hypermarkets, supermarkets, and convenience formats, and it currently operates in more than 40 countries, with strong presences in France, Spain, Italy, Belgium, Poland, and Latin America. (Carrefour Group, s. f.).

Carrefour's digital transformation has been shaped by significant investments in e-commerce, last-mile innovation, and data-driven logistics. Since 2018, the company has implemented its strategic plan "Carrefour 2022" and subsequently "Carrefour 2026", which is focused on four key drivers, the acceleration of e-commerce, the ramp-up of data and retail media activities, the digitization of financial services, and the digital transformation of traditional retail operations (Carrefour Group, s.f.). Partnerships with Glovo and Uber Eats for rapid delivery, the deployment of dark stores and micro-fulfilment centres, and the use of data analytics for route optimisation and inventory visibility are a few of their current strategies in Spain (Carrefour, July 2019; Digital Retail Strategy 2026 | Carrefour Group, s.f.).

Carrefour uses a collaborative model, forming partnerships with logistics firms, digital platforms, and technology startups. They have also created Carrefour Links (its data intelligence platform), which is their own digital ecosystem, and they have acquired or collaborated with delivery specialists (Digital Retail Strategy 2026 | Carrefour Group, s.f.).

Carrefour's combination of scale, international presence, and investment in digital initiatives makes it a relevant case for examining how large grocery retailers adapt their logistics and service models to ongoing digital transformation. Analysing Carrefour alongside Mercadona allows for an understanding of how different organisational contexts shape innovation strategies in last-mile delivery in the grocery sector.

2. Literature review

This chapter provides the background to address the central research question: "*How can large grocery retailers implement digital transformation strategies, through technological innovations, that address the inefficiencies and complexities in last-mile delivery?*".

Before analysing the case studies of Mercadona and Carrefour, it is essential to review how digital transformation has been investigated in retail logistics, with a focus on last-mile delivery. This review clarifies the dynamics and technologies shaping digital transformation in the industry and serves as a foundation for the case study analysis.

The chapter moves from the general picture to the object of study. It begins with an overview of digital transformation in retail logistics and identifies key trends and technological developments. It then narrows the focus to last-mile delivery, the process most relevant to this thesis. This approach ensures a logical progression and situates the case studies within the broader context of digital transformation in retail.

This chapter serves two primary functions. First, it reviews the current state of knowledge on digital transformation in logistics, clarifying the inefficiencies and complexities related to last-mile delivery. Second, it establishes a foundation for the subsequent analysis of Mercadona's and Carrefour's digital transformation strategies in this area.

2.1. Digital Transformation in Retail Logistics

Digital transformation in retail logistics refers to the adoption and usage of digital technologies into logistics operations with the aim of improving efficiency, customer experience, responsiveness, traceability and transparency across the supply chain (Tubis et al., 2023; Mashalah et al., 2022; Tabim et al., 202; Deschutter et al., 2025). It involves a reconfiguration of processes, capabilities, technological infrastructure, strategies and decision-making models to enable data-driven and service-oriented logistics (Tubis et al., 2023; Sharma et al., 2025; Deschutter et al., 2025). In the retail sector, this transformation affects activities such as order management, inventory coordination, transport planning, warehousing, decision-making, and last-mile fulfilment, creating new forms of coordination between physical and digital channels (Tubis et al., 2023; Mangiaracina et al., 2019; Ieva et al., 2025; Tathed, 2025).

In grocery retail in particular, digital transformation has gained increasing strategic relevance because of the rising demand for online shopping, operational pressures in urban environments, and the need to manage perishable goods under strict time and temperature constraints (Viu-Roig & Álvarez-Palau, 2020; Boysen et al., 2020; Sorooshian et al., 2022). In Spain, for example, the growth of food delivery according to *Statista's Online Food Delivery Report 2019*, is growing at 10.7% (Viu-Roig & Álvarez-Palau, 2020). The growth of e-commerce has accelerated the adoption of technologies that improve speed, and flexibility, while simultaneously reducing cost and environmental impact (Viu-Roig & Álvarez-Palau, 2020; Alverhed et al., 2024). As a result, digital transformation in retail logistics refers to an integrated ecosystem of tools, data flows, and organisational practices that enable real-time decision-making and customer-centric delivery models (Sharma et al., 2025; Tabim et al., 2024).

This digitalisation involves coordination from multiple actors (retailers, platforms, logistics partners, technology providers) and across different stages of the supply chain (Tubis et al., 2023; Mangiaracina et al., 2019; Deschutter et al., 2025). Logistics, therefore, do not only benefit from the adoption of technological tools but also undergoes a digital transformation that affects the network design, service configuration and innovation dynamics (Sharma et al., 2025). This is especially relevant in the context of last-mile delivery, where cost pressures, consumer expectations, and sustainability requirements drive the adoption of digital solutions at an unprecedented rate (Boysen et al., 2020; Karaoulanis et al., 2024).

Digital transformation in retail logistics reshapes the entire supply chain, from inventory and warehousing to transport and decision-making. However, its implications are particularly pronounced in last-mile delivery, which represents the most resource-intensive, customer-facing, and sustainability-sensitive stage of the supply chain (Mangiaracina et al., 2019; Agatz et al., 2025; Demir et al., 2022; Na et al., 202; Boysen et al., 2020). This process concentrates the main challenges that grocery retailers must address due to cost pressures, urban constraints, and growing consumer expectations (Mangiaracina et al., 2019; Agatz et al., 2025; Stevenson & Rieck, 2024; Karl, 2024). By focusing on this area, this thesis positions itself within the discussion of digital transformation, zooming into the stage where digital transformation is most urgently needed and most impactful in logistics.

2.2. Last-Mile Delivery

Last-mile delivery refers to the final stage of the distribution process, in which goods are transported from a local hub, warehouse, store, or micro-fulfilment centre to the end consumer (Mangiaracina et al., 2019; Zhang & Demir, 2025; Boysen et al., 2021; Sorooshian et al., 2022). It is the most visible and consumer-facing component of the logistics chain and plays a decisive role in customer satisfaction, service differentiation, and competitiveness (Demir et al., 2022; Na et al., 202; Boysen et al., 2020). In retail logistics, the last mile encompasses both home delivery and other formats such as click-and-collect, parcel lockers, and pick-up points, which have emerged to accommodate evolving consumer expectations for speed, flexibility, and convenience (Boysen et al., 2021; Zhang & Demir, 2025; Sorooshian et al., 2022). Additionally, the growing relevance of last-mile delivery is directly linked to the rise of e-commerce (Sharma et al., 2025; Viu-Roig & Álvarez-Palau, 2020). Specially, in the grocery retail sector, the need to preserve product quality of perishable goods, heightens the importance of coordination, traceability, and timing in the last mile delivery process (Sharma et al., 2025; Hübner et al., 2016).

From an economic perspective, last-mile delivery is often recognised as the most resource-intensive and costly element of the supply chain, accounting for up to half of total logistics expenditure in e-commerce operations (Mangiaracina et al., 2019; Agatz et al., 2025). This cost intensity stems from fragmented delivery points, time-sensitive operations, fleet, type of delivery, market and environmental considerations (Boysen et al., 2020; Demir et al., 2022). As a result, addressing last-mile inefficiencies and complexities has become both a strategic and operational priority.

Moreover, to address the inefficiencies and complexities in last mile delivery, retail could be embedded within an omnichannel structure that bridges physical and digital environments, requiring retailers to coordinate inventories, fulfilment centres, transportation networks, and digital platforms. The integration of micro-fulfilment centres, delivery platforms, and data-driven decision systems can create a shift toward flexible logistics structures capable of adapting to consumer-driven demand variability. In this context, last-mile delivery is a logistical challenge, that benefits from digital transformation, especially in grocery e-commerce.

2.2.1. Inefficiencies and Complexities in Last-mile logistics

The last-mile is broadly recognised as the most expensive and resource-intensive stage of e-commerce logistics, due to fragmented drop-points, operational variability, and tight service windows (Mangiaracina et al., 2019; Agatz et al., 2025). Within this thesis, inefficiencies and complexities are treated as distinct analytical constructs. Inefficiencies refer to misallocation in the resources such as costs, time, labour and routing productivity. Complexities refer to structural interdependence, multiple actors, nodes, fulfilment formats, perishability and synchronisation, that make last-mile inherently difficult to coordinate. The following sub-sections summarise the inefficiencies and complexities characteristic of last-mile delivery which are used as conceptual anchors in the analytical chapter (Chapter 5).

1) Inefficiencies in Last mile

A set of recurrent inefficiencies is consistently highlighted in last-mile literature. First, delivery operations often suffer from route inefficiencies, because of low-stop density and narrow time windows, this is reflected in unnecessary kilometres, increase of time and cost per order (Demir et al., 2022; Pahwa & Jaller, 2022). Second, in-store order preparation can generate bottlenecks (interference with in-store shoppers, high picking time) which can be addressed through micro-fulfilment centres by separating online preparation from store environment (Hübner et al., 2016; Karaoulanis, 2024). Third, grocery perishability increases the incidence of overstock, stockouts and waste, as inventory replenishment cycles are short and highly sensitive to demand volatility (Birkmaier et al., 2024; Hübner et al., 2016). Fourth, home-delivery models can lead to high operating costs and energy consumption, particularly when fleet utilisation is low or time-windows are narrow (Viu-Roig & Álvarez-Palau, 2020; Ferreira & Esperança, 2025). Finally, digital ordering can also present frictions: complex browsing, slow interfaces or non-intuitive checkout flows increase the time required to place an order, constituting an inefficiency in the digital interface layer (Hübner et al., 2016; Mangiaracina et al., 2019; Karaoulanis, 2024). Altogether, these inefficiencies illustrate how last-mile productivity is eroded simultaneously in routing, fulfilment, inventory and customer-facing stages.

2) Complexities in Last mile

Last-mile complexity arises from interdependence between actors, nodes and fulfilment logics. Grocery retailers must synchronise demand signals across stores, fulfilment centres and platform-enabled delivery nodes, a multi-node orchestration problem intensified by perishability (Hübner et al., 2016; Demir et al., 2022). Urban congestion and sustainability pressures add further variability, affecting routing reliability and fleet composition decisions (Viu-Roig & Álvarez-Palau, 2020; Ferreira & Esperança, 2025; Agatz et al., 2025). Moreover, the coexistence of home delivery, Click&Collect and other delivery methods multiply the volume of potential fulfilment paths for the same order, increasing information complexity and service coordination needs (Hübner et al., 2016). Finally, third-party platform delivery introduces multi-actor coordination complexity, where data, assets and service execution are distributed across partners.

Taken together, these dimensions show that inefficiencies and complexities are not equivalent: inefficiencies reflect misallocation in resources, while complexities reflect the structural conditions that make those losses harder to avoid.

2.2.2. Key technologies

The digital transformation of last mile is driven by a set of technologies that enable data integration, operational optimisation, and the development of new delivery models (Mashalah et al., 2022; Sharma et al., 2025). These technologies do not function independently; rather, they create a digital infrastructure that interconnects consumers, retailers, and logistics actors in real time (Mangiaracina et al., 2019; Tabim et al., 2024).

Artificial Intelligence (AI) and algorithmic optimisation play a central role in forecasting demand, inventory allocation, decision-making, and route planning in e-commerce logistics by processing vast amounts of data (Tathed, 2025; Sharma et al., 2025; Deschutter et al., 2025). In the context of grocery retail and food logistics, these tools could be used to improve delivery reliability and address inefficiencies in perishable goods distribution. AI and machine learning tools also enhance operational efficiency and effectiveness in warehouses, where rapid order preparation is essential to meet customer expectations (Tubis et al., 2023).

Big data and advanced analytics enable retailers to process large volumes of operational and customer information, improving visibility across the supply chain and supporting responsive and data-driven logistics decisions (Mashalah et al., 2022; Demir et al., 2022; Karaoulanis, 2024; Deschutter et al., 2025). It also improves supply chain efficiency, particularly in last-mile delivery (Mashalah et al., 2022). The integration of data between warehouses, physical stores, and online platforms could allow real-time follow up, monitorization of performance and adaptation of strategies, which are important aspects in last mile.

Mobile applications and digital platforms act as key customer interfaces, enabling order placement, delivery scheduling, communication, and click-and-collect services (Sharma et al., 2025). In the case of supermarkets, these systems could also generate behavioural and transactional data that feed back into logistics planning and customer retention strategies.

Smart lockers and pick-up solutions have become particularly relevant in dense urban environments, helping reduce failed deliveries and improve customer convenience while lowering operational costs, emissions and improving delivery reliability (Boysen et al., 2020; Zhang & Demir, 2025). These systems are integrated with digital platforms and provide flexibility to customers and logistics providers (Mangiaracina et al., 2019).

Autonomous vehicles, drones, and delivery robots are emerging as experimental but increasingly viable alternatives for last-mile logistics. Although adoption remains limited, they are viewed as potential solutions to reduce labour costs, congestion, and environmental impact (Alverhed et al., 2024; Boysen et al., 2020; Engesser et al., 2023; Ieva et al., 2025; Deschutter et al., 2025).

Internet of Things (IoT) technologies enhance traceability and operational control along logistics chains. Sensors and connected systems monitor temperature, stock levels, vehicle performance, and delivery status, ensuring real-time visibility and responsiveness (Tubis et al., 2023; Demir et al., 2022; Deschutter et al., 2025). In perishable goods logistics, these applications are particularly relevant for meeting safety and quality requirements.

Together, these technologies support the shift from traditional, linear logistics models to digitally coordinated systems that are faster, more transparent, and adaptable to fluctuating demand (Sharma et al., 2025; Tabim et al., 2024). In the grocery retail sector, where margins are tight and customer expectations are immediate, the strategic integration of these digital tools has become essential.

2.2.3. Innovative Strategies

Addressing inefficiencies and complexities in last-mile delivery has become a strategic priority for retailers, logistics operators, and urban authorities seeking to reduce costs, emissions, and operational fragmentation (Mangiaracina et al., 2019; Demir et al., 2022;

Ferreira & Esperança, 2025; Viu-Roig & Álvarez-Palau, 2020). One of the most widely adopted strategies is the development of **micro-fulfilment centres** and **dark stores**. Micro-fulfilment centres are small-scale, highly automated warehouses located in urban areas, designed to process online orders quickly and cost-effectively (Karaoulanis, 2024; Na et al., 2021). Dark stores are retail outlets closed to the public and repurposed exclusively for fulfilling e-commerce orders (Karaoulanis, 2024; Boysen et al., 2020). Both formats enable proximity-based inventory positioning and shorten delivery distances, thereby enhancing the speed and efficiency of last-mile operations (Karaoulanis, 2024; Boysen et al., 2020; Na et al., 2021). These facilities, often located in urban or peri-urban areas, reduce lead times and allow for rapid order consolidation, especially for groceries and fast-moving consumer goods (Tabim et al., 2024; Karaoulanis, 2024; Demir et al., 2022). By decentralising stock away from traditional distribution centres, retailers achieve higher delivery density and improved service responsiveness (Na et al., 2021; Karaoulanis, 2024).

Parcel lockers, pick-up points and click-and-collect models further address inefficiencies and complexities by aggregating multiple orders in a single location. This reduces failed delivery attempts and last-mile travel distances, as well as congestion in home delivery routes while offering customers flexibility and convenience and benefiting from lower labour costs (Viu-Roig & Álvarez-Palau, 2020; Zhang & Demir, 2025).

Another key strategy lies in **route optimisation and data-driven planning**. The use of AI, machine learning, and advanced analytics enables dynamic routing, demand forecasting, and real-time reallocation of resources (Ieva et al., 2025; Tubis et al., 2023; Tathed, 2025). These systems help improve vehicle utilisation, consolidate deliveries, and reduce fuel consumption (Tathed, 2025). They support adaptive scheduling and time-slot differentiation, aligning delivery routes with customer preferences and operational constraints (Ieva et al., 2025; Tubis & Rohman, 2023).

Collaborative and shared logistics models are gaining relevance as a means of reducing duplicated trips and increasing vehicle load factors. Cooperation between carriers, platforms, or retailers can make them share resources, use common city warehouses, and provide delivery services that work smoothly with each other (Agusdei et al., 2022; Boysen et al., 2020). This approach could be particularly effective in cities where space is constrained, and delivery densities need to be maximised.

In parallel, the adoption of **electric vehicles (EVs) and low-emission fleets** is becoming integral to efficiency and sustainability strategies. EVs reduce environmental impact and comply with urban emission regulations, while advances in battery technology make them increasingly viable for short-range urban routes (Ferreira & Esperança, 2025). Some operators also explore **cargo bikes and micro-vehicles**, which offer high manoeuvrability and access to restricted urban areas, contributing to reduced congestion and quicker deliveries (Viu-Roig & Álvarez-Palau, 2020; Boysen et al., 2020).

Autonomous delivery solutions, including drones, self-driving vans and delivery robots, are emerging as future-oriented strategies with potential to reshape last-mile operations. Although still limited by regulation, infrastructure and cost barriers, they promise to reduce labour dependency and enhance delivery scalability in specific contexts (Boysen et al., 2020; Engesser et al., 2023; Alverhed et al., 2024).

Digital platforms play a central role in synchronising these strategies. They integrate tracking, customer communication, and inventory data, enabling real-time visibility and coordination between actors (Tubis & Rohman, 2023).

Ultimately, addressing the inefficiencies and complexities in last-mile delivery depends on the interplay between infrastructure design, technological adoption, and stakeholder coordination. Rather than relying on a single solution, firms could benefit from deploying a combination of proximity-based fulfilment, digital optimisation tools, delivery consolidation models and sustainable fleet strategies.

2.2.4. Implications in the supermarket industry

The digital transformation of last-mile logistics can have particularly significant implications for the supermarket industry due to the unique characteristics of grocery products and consumer expectations. Compared with other retail sectors, grocery delivery requires strict temperature control, time sensitivity, and delivery precision. These operational constraints can make inefficiencies and complexities in the last mile especially critical, as they directly affect product quality, customer satisfaction, and profitability.

The accelerated growth of online demand has forced retailers to redesign their distribution networks and logistics processes. Digital transformation enables this adaptation by integrating technologies such as automated fulfilment systems, real-time tracking, data analytics, and AI-based demand forecasting. Through these tools, retailers can address inefficiencies related to picking, routing, and inventory accuracy, as well as complexities arising from multi-channel coordination and perishability.

One key implication of this transformation is the reconfiguration of fulfilment models. The adoption of proximity-based infrastructures, such as dark stores and micro-fulfilment centres, allows for faster order preparation and shorter transport distances (Karaoulanis, 2024). While these infrastructures are physical, their effectiveness depends on digital systems, automated picking, real-time inventory management, and data-driven demand forecasting, that optimise operations. This digital layer is crucial because traditional in-store picking often generates congestion, inefficiencies, and stock discrepancies when online and offline channels overlap (Hübner et al., 2016; Birkmaier et al., 2024; Karaoulanis, 2024). By relocating preparation tasks away from consumer-facing stores, supermarkets can increase picking speed, improve freshness control, and reduce delivery lead times.

Another important implication is the integration of digital interfaces. Platforms and mobile applications facilitate real-time communication, subscription and slot-based delivery models, and click-and-collect services, allowing consumers to integrate grocery orders into their daily routines (Hübner et al., 2016). These systems also can generate behavioural and operational data that support route optimisation, targeted promotions, and stock allocation decisions (Mangiaracina et al., 2019; Karaoulanis, 2024).

Ultimately, the coexistence of physical stores, online channels, and hybrid collection formats reinforces digital transformation as a strategic necessity rather than a complementary process. The specific constraints of the supermarket industry, perishability, frequency, and cost sensitivity, intensify the logistical demands of the last mile. As a result, digital transformation becomes not only a driver of competitive differentiation but also a condition for operational viability. This explains why the supermarket sector provides a particularly relevant context for studying how technological innovation can address inefficiencies and complexities in last-mile delivery.

3. Approaches to Organising and Sourcing for Innovation

This chapter presents the approaches that guide the analysis of digital transformation in retail logistics. Two perspectives are adopted: Organising for Innovation and Sources of Innovation. The first examines how firms' structure and govern the innovation process, while the second explores the origins from which innovations emerge. Placing these frameworks in sequence allows the thesis to first understand how innovation is organised before analysing why and from where it arises.

Organising for Innovation refers to the structures and mechanisms through which companies coordinate their innovation activities. Firms may rely on more centralised models, where decision-making and resource allocation are concentrated within a dedicated unit, or on decentralised models, where innovation is distributed across different organisational levels (Schilling, M., 2019). Within these structures, firms may choose to innovate through closed approaches, developing solutions internally, or through open approaches, collaborating with external actors such as startups, universities, or logistics partners (Schilling, M., 2019; Chesbrough, 2003). These organisational choices can shape the speed, scope, and flexibility of innovation, and condition how digital transformation strategies can be implemented.

Sources of Innovation, on the other hand, focuses on the drivers behind innovation initiatives. Innovations may emerge as need-pull responses, where companies address market demands, or as technology-push developments, enabled by the opportunities created through new technological advances (Hötte, 2021).

By combining these perspectives, the thesis develops an integrated framework that links organisational design (how innovation is structured and approached) with sources of innovation (why and from where innovation arises). This dual lens provides the analytical foundation to go beyond a descriptive account of Mercadona's and Carrefour's practices and instead explain the mechanisms through which their digital transformation strategies in last-mile delivery take shape. In doing so, the framework makes it possible to assess how certain technology innovations can address inefficiencies and complexities in last-mile, and how do companies develop these innovations and structure the organisation to incorporate these, thereby offering lessons that may guide other retailers facing similar challenges in the grocery sector.

3.1. Organising for Innovation

Organising for innovation refers to how firms design their structures, processes, and governance mechanisms to ensure that ideas are not only generated but also transformed into solutions that create value. As Schilling (2019) notes, organisational design can be just as decisive for innovation outcomes as innovation themselves. Innovation therefore requires more than creativity: it depends on how firms structure authority, allocate resources, and manage knowledge flows both internally and externally (Schilling, M., 2019).

Elements such as formalization, standardization, and internal controls directly influence the likelihood of innovating, the effectiveness of projects, and the speed of new product development processes (Schilling, M., 2019). Additionally, decisions about the firms' structure, such as centralised versus decentralised play a crucial role: centralised structures enable tighter control, consistency, and efficiency, while decentralised structures foster flexibility, responsiveness, and greater involvement of diverse actors in the innovation process (Schilling, M., 2019). In the context of digital transformation, these organisational choices become particularly relevant. Grocery retailers must integrate advanced technologies while coordinating across partners and increasingly complex supply chains.

Within organising for innovation, two complementary models for approaching innovation are often distinguished: closed innovation, where firms rely mainly on internal capabilities and knowledge, and open innovation, where they engage purposefully with external actors, partnerships, and networks. Taken together with the centralised–decentralised dimension, these models provide a powerful lens for analysing how large grocery retailers organise their innovation processes in last-mile delivery. (Schilling, 2019)

The differentiation between centralised and decentralised, refers to the structure of the company. **Centralisation** refers to decision-making and innovation processes being concentrated at the top of the organisation, typically within dedicated R&D units, digital hubs, or innovation labs. This structure emphasises coherence, standardisation, and strategic control, allowing companies to align innovations with global priorities and achieve economies of scale. By contrast, **Decentralisation** allows different business units, stores, or regional subsidiaries to develop and implement their own innovations. This promotes flexibility, responsiveness, and local adaptation, as units can experiment and customise solutions to specific market conditions. However, it also risks duplication of efforts, inconsistent practices, and weaker integration across the company. (Schilling, M., 2019)

The differentiation between open or closed innovation, refers to the way firms organise for innovation, the approach the companies have for innovation. **Closed** innovation refers to models where firms rely predominantly on internal resources and knowledge to develop solutions. Here, innovation is contained within organisational boundaries, often ensuring efficiency, control, and intellectual property protection. In contrast, **Open** innovation is based on the principle that valuable knowledge exists both inside and outside the firm, and that collaboration with external partners, such as startups, universities, suppliers, municipalities, or even customers, can accelerate and broaden innovation. Open innovation can take inbound, outbound, or coupled forms, reflecting the different ways knowledge flows across organisational boundaries. (Schilling, M., 2019)

While these dimensions are often discussed separately, their intersection reveals four distinct models seen in Figure 1 (Schilling, M., 2019).

Closed and Centralised	Tightly controlled innovation, fully managed by corporate headquarters or central R&D.
Closed and Decentralised	Independent internal initiatives developed in different departments, but without external collaboration.
Open and Centralised	Partnerships and collaborations are managed by a central innovation hub, which decides which external solutions are scaled across the company.
Open and Decentralised	Innovation comes from collaborations between business departments and external actors in specific contexts.

Figure 1: Dimensions to Organise for innovation

Each of these approaches presents different advantages and limitations for retailers undergoing digital transformation. Centralised and closed models ensure efficiency and consistency but may limit responsiveness to new opportunities (Schilling, M., 2019). Decentralised and open models maximise experimentation and adaptability yet face challenges of coordination and alignment (Schilling, M., 2019). In the context of last mile, these differences are particularly relevant: for instance, a centralised and closed approach may favour in-house routing systems, while a decentralised and open approach may encourage local pilots with startups for shared urban hubs.

By comparing these approaches, this thesis can better assess how Mercadona and Carrefour structure their innovation processes, and how these organisational choices affect their ability to implement digital transformation strategies that address logistics inefficiencies and complexities. Furthermore, in this thesis we will be focusing on the approaches that Carrefour and Mercadona are having on innovation, that is why, the models of open and closed innovation will be extended and explained further in the next chapters.

3.1.1. Closed innovation

Closed innovation refers to a model in which firms rely primarily on their own internal resources, capabilities, and R&D structures to generate, develop, and commercialise new ideas (Chesbrough, 2003; Schilling, 2019). Under this paradigm, the innovation process is contained within organisational boundaries, with strict control over knowledge flows and a strong emphasis on intellectual property protection (Chesbrough, 2003; Schilling, 2019). The firm is seen as a self-sufficient unit where innovation occurs through hierarchical processes, guided by internal decision-making and supported by proprietary assets (Chesbrough, 2003; Schilling, 2019).

Closed innovation is often associated with centralised organisational structures, where authority is concentrated at the top and knowledge flows are tightly managed. This centralisation enables coherence in strategy, consistent allocation of resources, and strong alignment of innovation with long-term goals. At the same time, closed innovation can also operate under decentralised forms, for example when different business units or internal teams are granted autonomy to develop new tools or processes, yet still within the boundaries of the firm. (Schilling, 2019)

One of the key advantages of closed innovation is coherence: by maintaining tight control over knowledge and development, firms ensure consistency in strategy, resource allocation, and technological trajectories. Closed models also support efficiency in environments where coordination and integration are critical, since internal governance reduces the complexity of managing external dependencies. Furthermore, the focus on internal capabilities enables more effective risk management, as sensitive knowledge and investments remain under the firm's control. (Chesbrough, 2003; Schilling, 2023)

However, the model also faces important drawbacks. By restricting knowledge flows, closed innovation can limit a firm's exposure to external sources of creativity and reduce opportunities for learning from customers, suppliers, or partners. This often results in slower adaptation to dynamic markets and can create path dependencies that hinder radical innovation. Companies following this model often assume that the most valuable knowledge resides internally, which can blind them to opportunities and technological advances arising outside their boundaries. (Chesbrough, 2003; Schilling, 2023)

In the field of logistics, closed innovation can be manifested in vertically integrated systems, where firms design and operate proprietary infrastructure, warehouses, and transportation networks. Retailers and logistics operators can focus on the in-house development of digital tools, such as inventory optimisation algorithms, proprietary routing systems, or exclusive data platforms for tracking and coordination. By doing so, they safeguard critical operational knowledge and retain strategic autonomy. While this approach can ensure reliability and protect competitive advantage, it may also slow down the adoption of frontier technologies that emerge outside the firm's boundaries.

3.1.2. Open Innovation

Open innovation represents a shift from the traditional view of the firm as a closed system towards one that actively leverages external actors and knowledge flows to drive innovation. Open innovation uses internal and external knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, this paradigm assumes that valuable ideas exist both inside and outside the firm, and that firms can benefit by collaborating rather than innovating in isolation. (Chesbrough, 2003)

Organisationally, open innovation can be implemented in both centralised and decentralised forms. In a centralised open model, a company controls and coordinates external collaborations through dedicated innovation hubs, digital labs, or central R&D units that decide which external inputs are integrated. This provides coherence and oversight, ensuring that external partnerships remain aligned with overall strategy. By contrast, in a decentralised open model, authority is more distributed: multiple teams or business units interact directly with external partners, creating a network of collaborations that fosters experimentation and diversity of ideas, but also introduces greater complexity in coordination. (Schilling, 2019)

Open innovation takes different forms. Inbound innovation involves sourcing knowledge externally, such as by collaborating with universities, suppliers, customers, or startups. Outbound innovation refers to sharing or licensing internal technologies for external use, thus creating new revenue streams and stimulating complementary innovations. A third form, coupled innovation, combines both, often through alliances, joint ventures, or consortia that enable reciprocal knowledge flows. (Chesbrough, 2003; Schilling, 2019)

The advantages of open innovation are significant. By tapping into a broader network of knowledge sources, firms gain agility in responding to environmental changes, access to diverse expertise that may be unavailable internally, and opportunities for accelerated digital transformation (Schilling, 2023). This model also enhances the potential for radical innovation, as firms can integrate frontier technologies and novel ideas that challenge established practices (Chesbrough, 2003; Schilling, 2019).

However, open innovation also presents risks. Firms may face a loss of control over intellectual property and core knowledge, increasing concerns about appropriation and competitive imitation. Dependence on external partners can also create vulnerabilities, while the need to coordinate across organisational and cultural boundaries adds complexity to governance and project management. (Chesbrough, 2003; Schilling, 2019)

In the logistics sector, open innovation can be particularly relevant in the context of digital transformation. Partnerships with technology startups could enable established firms to experiment with artificial intelligence, or robotics without committing to full in-house development. Some can adopt centralised open approaches, where innovation labs screen and integrate technologies into the firm's logistics strategy. Others can follow decentralised open models, enabling local teams or regional business units to pilot partnerships with logistics providers or municipalities, for example by experimenting with shared urban distribution hubs. These practices illustrate how open innovation allows supermarkets such as Carrefour and Mercadona to reshape their last-mile delivery processes into more adaptive, interconnected, and sustainable systems.

3.2. Sources of Innovation

The study of innovation has long recognised that new ideas and practices do not emerge randomly but are shaped by identifiable sources of innovation (Tidd & Bessant, 2018). These sources describe the origins of innovative activity, the actors involved in its generation, and the conditions under which ideas are mobilised into organisational processes (Tidd & Bessant, 2018). Understanding these sources is crucial, as they explain not only where innovations come from but also how they are transformed into outcomes that affect industries, markets, and society (Tidd & Bessant, 2018).

Traditionally, scholars distinguished between internal sources, arising from within the organisation (such as research and development, employee creativity, or internal problem-solving), and external sources, linked to actors and pressures beyond organisational boundaries (such as customers, suppliers, competitors, or regulation) (Tidd & Bessant, 2018). While useful, this distinction alone is insufficient to capture the dynamics of contemporary innovation processes, particularly in industries undergoing digital transformation.

A complementary and widely used distinction classifies innovations according to their driving forces: technology-push and need-pull (Rothwell, 1994; Hötte, 2021; Maier et al., 2016).

Technology-push innovations emerge from advances in scientific knowledge, technological capabilities, or external providers of new tools (Hötte, 2021). In this case, the supply of new technological possibilities precedes and enables new applications, often independent of market demand pull (Rothwell, 1994; Hötte, 2021; Maier et al., 2016). These innovations are typically associated with higher uncertainty and longer development cycles, but they can lead to radical breakthroughs (Rothwell, 1994; Hötte, 2021).

Need-pull innovations, by contrast, are initiated by unmet demands, operational inefficiencies, or regulatory and societal pressures that compel organisations to seek solutions (Tidd & Bessant, 2018; Hötte, 2021). Here, the starting point is a need, rather than a technological breakthrough, and innovation is oriented towards satisfying this demand (Tidd & Bessant, 2018). Need-pull trajectories often generate incremental innovations with shorter time horizons (Rothwell, 1994; Maier et al., 2016).

Over time, research has shown that push and pull are not mutually exclusive but interdependent and complementary (Rothwell, 1994; Maier et al., 2016). Rothwell's analysis of innovation models highlights how early linear perspectives (first- and second-generation push or pull models) evolved into "coupling" models that emphasise interaction between market and technology. Similarly, Maier et al. (2016) stress that effective innovation management requires simultaneous attention to both sources, mediated through organisational capabilities that balance technological opportunities with market trends.

For the purposes of this thesis, the classification of innovation sources into technology-push and need-pull provides a useful analytical framework. It allows the researcher to examine how digital transformation in last mile is shaped both by technological advances, such as AI, robotics, and automation, and by the structural pressures of the retail industry, including consumer or providers expectations among others. This dual perspective is essential to explain why and how retailers adopt and develop specific technological innovations, and how these choices reflect broader dynamics within the grocery retail sector.

3.2.1. Need-pull Innovations

Need-pull innovation refers to innovations that are initiated as a direct response to identified needs, market demands, or consumer expectations (Hötte, 2021; Tidd & Bessant, 2018). Rather than being driven by technological advances, these innovations originate from problems to be solved, or opportunities perceived by customers, users, providers or broader social pressures (Tidd & Bessant, 2018). In this perspective, the market acts as the primary source of innovation, guiding firms toward solutions that are immediately relevant and valuable.

The mechanisms through which need-pull innovations emerge are diverse. User feedback and co-creation processes allow companies to capture first-hand insights into customer preferences and pain points, while data analytics increasingly play a central role in detecting latent needs through behavioural patterns and consumption trends (Von Hippel, 2005; Tidd & Bessant, 2018; Mashalah et al., 2022; Tubis & Rohman, 2023; Boysen et al., 2020). In service industries such as retail logistics, customer requirements related to speed, convenience, and sustainability often trigger the development of new delivery models or service adaptations (Mangiaracina et al., 2019).

The demand-pull model of innovation was articulated in the classic work of Rothwell (1994), seen in Figure 2, who described innovation as a linear sequence starting from perceived market needs. In this view, the process begins with customers or users articulating unmet requirements, which then stimulate research, development, and subsequent market introduction (Rothwell, 1994). This linear demand-pull perspective emphasises the primacy of the market as the driver of technological change.

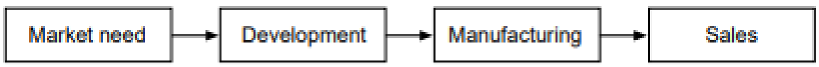

Figure 2: Rothwell's demand-pull model (Rothwell, 1994)

The main advantage of need-pull innovation lies in its ability to ensure market relevance. By aligning solutions with articulated or observed needs, companies increase satisfaction and reduce the risk of misalignment between offerings and demand (Tidd & Bessant, 2018; Von Hippel, 2005). This demand-driven orientation also supports incremental improvements, especially in mature sectors where competition revolves around differentiation and customer-centric services (Hötte, 2021).

However, the reliance on market needs also presents risks. A strong need-pull orientation may constrain radical innovation, as it positions firms in a reactive mode, responding to existing needs rather than anticipating or shaping future markets (Tidd & Bessant, 2018).

As the theory of disruptive innovation posits, focusing too heavily on current markets can blind organisations to emerging opportunities or underserved markets (Tidd & Bessant, 2018).

Illustrative examples of need-pull innovation can be found across different industries. In logistics, the rising demand for sustainable delivery options has led to innovations such as cargo bikes and low-emission fleets, directly responding to municipal and consumer pressures (Viu-Roig & Álvarez-Palau, 2020; Boysen et al., 2020). Similarly, the demand for rapid and flexible fulfilment in e-commerce has stimulated the development of last-mile optimisation solutions, click-and-collect services, and micro-fulfilment centres (Viu-Roig & Álvarez-Palau, 2020). These cases exemplify how customer and societal needs can operate as powerful drivers of innovation, particularly in highly competitive and service-oriented sectors.

3.2.2. Technology-Push Innovations

Technology-push innovation refers to the development and diffusion of new products, processes, or services primarily enabled by advances in science and technology, rather than by pre-existing market demand (Tidd & Bessant, 2018). In this perspective, the generation of new knowledge, through research, experimentation, and prototyping, creates technical possibilities that firms seek to transform into commercial applications (Tidd & Bessant, 2018).

Typical channels of technology-push include formal R&D, pilot projects and prototypes, technology transfer from universities and research centres, and collaborations with technology providers introducing new tools and platforms (Tidd & Bessant, 2018). Firms engaging in R&D could leverage frontier technologies such as artificial intelligence, robotics, or the Internet of Things (IoT), which enable efficiency gains and could create novel business models. Collaborations between industry and academia also act as an important channel for technology-driven innovation, fostering the transfer of knowledge and accelerating commercialisation (Tidd & Bessant, 2018).

The classic linear technology-push model is described by Rothwell (1994) as a sequential process in which innovation begins with scientific research, moves through technological development and production, and ultimately reaches the market. In this view, demand is not the starting point, but rather a recipient of solutions that arise from technological progress. The model assumes that scientific discovery inherently generates innovation opportunities, which then "push" their way into the economy through firms' R&D activities (Rothwell, 1994).

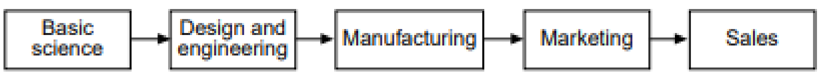

Figure 3: Rothwell's technology-push model (Rothwell, 1994)

Technology-push innovations bring several advantages. They can generate disruptive change by enabling capabilities that were not previously available, fostering efficiency, scalability, and differentiation (Tidd & Bessant, 2018). By moving ahead of current demand, firms can create new markets or reshape existing ones, gaining first-mover advantages and positioning themselves as technological leaders (Rothwell, 1994; Maier et al., 2016). In logistics, the introduction of autonomous vehicles, warehouse automation, or predictive AI systems represents a paradigm shift in how goods are stored, routed, and delivered (Engesser et al., 2023; Ieva et al., 2025).

Nevertheless, this approach entails risks. A technology-push orientation can lead to misalignment with actual market needs, resulting in innovations that are technically sophisticated but lack adoption due to usability issues, cost barriers, or insufficient perceived value (Tidd & Bessant, 2018; Di Stefano et al., 2012).

Illustrative examples underline the role of technology-push innovations in retail and logistics. Warehouse robotics and automated storage systems have transformed fulfilment operations by increasing speed and reducing human error (Tubis & Rohman, 2023). AI-based routing tools are enabling predictive and dynamic optimisation of delivery fleets (Tathed, 2025). These examples illustrate how technological advances, often developed ahead of demand, become enablers of future market structures and business models.

3.2.3. Coupling model

The distinction between technology-push and need-pull innovation has been central to innovation studies for decades. However, these two models should not be viewed as mutually exclusive. Rothwell (1994), in his review of innovation models, emphasises that real world innovation rarely follows a purely linear trajectory. Instead, successful innovations often emerge from an interactive process in which technological opportunities and market needs influence one another over time.

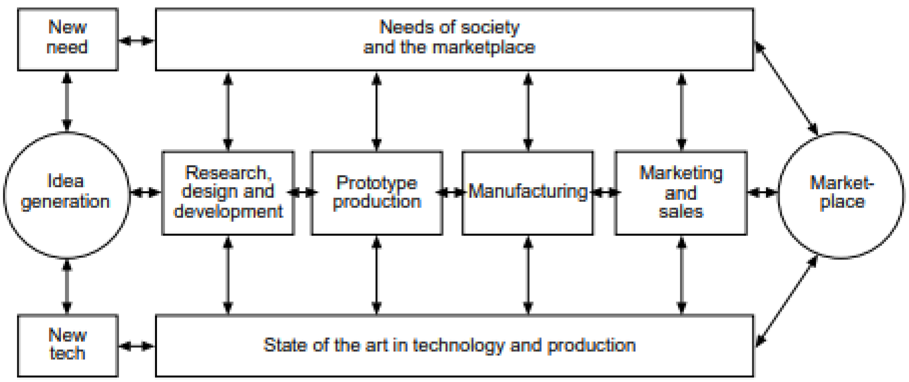

Figure 4: Rothwell's coupling model (Rothwell, 1994)

In the classical linear view, innovation was either the outcome of scientific and technological advances diffusing toward the market (push) or the result of firms responding to explicit user needs (pull). Rothwell's coupling model challenges this dichotomy by describing innovation at the process level, showing that technological developments and market feedback continuously interact and shape innovations (Rothwell, 1994). In this model, push and pull are not alternatives but interconnected drivers within a single innovation trajectory (Rothwell, 1994).

Subsequent work has extended this interactive logic to the organisational level. Maier, Ho and Branzei (2016) argue that firms rarely rely on a single logic of innovation. Instead, they manage portfolios of innovations in which some initiatives arise from technology-push dynamics and others from need-pull forces (Maier et al., 2016). Through this strategic combination, organisations can themselves be characterised as operating under a coupling logic, even if individual innovations lean more strongly toward one direction (Maier et al., 2016). Thus, while Rothwell conceptualises coupling within individual innovation processes, Maier, Ho and Branzei highlight how coupling can also characterise organisational innovation strategies.

Understanding coupling at both levels is particularly relevant for last-mile delivery. Technological innovations in this domain frequently originate from advances in automation, data analytics, and digital platforms, yet their adoption and refinement depend on market pressures such as customer expectations, partner requirements, and operational constraints. Analysing innovations through this dual lens makes it possible to understand the source of Mercadona's and Carrefour's innovations and the degree to which they align technological possibilities with emerging needs.

Taken together, the synthesis of need-pull and technology-push perspectives reinforces the idea that digital transformation in retail logistics is not is not driven by one side alone but by the co-evolution between technology and demand. This integrated framework will therefore serve as a foundation for the empirical analysis of the case studies, where both forces will be observed in action.

3.3. Integrating the different approaches

The two approaches discussed above, Organising for Innovation and Sources of Innovation, address complementary dimensions of the innovation process. Taken together, they provide a lens for analysing innovation in logistics and retail. They both help answering the general research question: *"How can large grocery retailers implement digital transformation strategies, through technological innovations, that address the inefficiencies and complexities in last-mile delivery?"*. To answer this question, it is necessary to go beyond describing technological tools or operational practices. The aim is to understand the underlying dynamics that explain both the origins of digital transformation initiatives and the organisational mechanisms through which they are translated into strategies.

Organising for Innovation clarifies how firms manage and structure technological innovation. This includes decisions about whether innovation is coordinated in a centralised or decentralised manner, and whether firms pursue closed approaches (relying primarily on internal resources) or open approaches (collaborating with external actors such as startups, logistics partners, or technology providers). These organisational choices are critical in determining the scope, and flexibility with which digital transformation strategies can be implemented.

The framework of technology-push versus need-pull innovation is used to identify the drivers of digital transformation in last-mile delivery. This perspective helps determine whether innovations adopted by Mercadona and Carrefour are primarily responses to external pressures (such as consumer expectations for transparency, providers demand, or inefficiencies in existing logistics processes), or whether they originate from technological opportunities (such as advances in AI, blockchain, or robotics). In other words, this framework provides insight into the motivations and origins of innovation, thereby explaining why retailers prioritise certain digital solutions.

Although both frameworks are conceptually different, they are interrelated. From the researcher's point of view, closed and centralised configurations align with technology-push innovation, because they rely strongly on internal technological capabilities and development. In contrast, open and decentralised configurations, align with need-pull innovation, as they require proximity to customers, external partners, and collaboration. In other words: sources of innovation influence the organisational structure chosen, and organisational choices, in turn, shape which sources are likely to dominate.

Approach	**Source**	**Why**
Closed and Centralised	Technology-push	Internal R&D, control, technology introduced from inside the firm
Closed and Decentralised	Mixed/Technology-push	Technological innovations developed across units, but governed internally without external participation
Open and Centralised	Mixed/Need-pull	External knowledge is integrated, but still coordinated by a central innovation unit
Open and Decentralised	Need-pull	Innovation emerges close to external collaborators, co-creation and rapid iteration

Figure 5: Correlation between Organising and Sourcing for innovation

This integrated approach is especially relevant for analysing digital transformation in the context of last-mile delivery, where retailers must simultaneously respond to external pressures (consumer and providers expectations) and leverage new technologies (AI, IoT, automation, etc.). By situating company strategies at the intersection of sources and organisational forms, the framework enables a structured interpretation of how Mercadona and Carrefour build digital transformation pathways that target inefficiencies and complexities.

Finally, this integration directly structures the analytical approach in Chapter 5. Since neither Mercadona nor Carrefour explicitly state whether a given innovation is “push” or “pull”, or whether it is governed through “open” or “closed” structures, these dimensions will necessarily be interpreted by the researcher. This interpretation is based on three observable indicators: where the innovation originates (internal development or external partnerships), the type of digital technologies leveraged, and the extent to which the drivers behind the innovation appear to align with technology-push or need-pull sources.

Chapter 3 therefore provides the conceptual categories (technology-push / need-pull and open / closed and centralised / decentralised) that structure the analysis of the case studies in Chapter 5. The analysis of the cases will then be used to infer which organising and sourcing configurations are most likely present in each company. This interpretive mapping is what directly answers the second sub-research question, and, through that, contributes to answering the general research question.

4. Methodology

To establish the foundation for the analysis and to provide an answer to the research question, this chapter presents the methodological approach adopted in the thesis. The study a case study design of Mercadona and Carrefour, two leading grocery retailers operating in the Spanish market. Additionally, it adopts a qualitative research design based on secondary data, drawing from academic literature, industry reports, corporate documents, and publicly available sources.

The purpose of this chapter is to explain how these data were identified, selected, and analysed, and to clarify the criteria used to ensure the credibility, reliability, and validity of the findings. By detailing the procedures followed in the collection and interpretation of secondary sources, the chapter establishes the methodological transparency necessary to support the empirical and theoretical analyses presented in the following chapters.

4.1. Research design

This thesis adopts a qualitative case study design, focusing on two leading actors in the Spanish grocery retail sector: Mercadona and Carrefour. The choice of a multiple-case approach follows the logic proposed by Yin (2018), in which the comparison of different organizational settings enhances analytical depth and strengthens the robustness of the findings. By contrasting these two cases, the study explores how distinct strategic and organizational approaches shape the digital transformation in last-mile delivery.

The analysis relies exclusively on secondary sources of information. Secondary sources offer access to a wide variety of perspectives, studies and information, allowing for a multidimensional understanding of the cases. The materials include:

- Company reports (annual reports, sustainability reports, logistics strategies).
- Industry publications and market analyses (retail and logistics sector studies, consultancy reports).
- Press releases and news articles that provide insights into recent initiatives and innovation projects of the companies.
- Academic literature examining retail innovation, digital transformation, and logistics practices.

Moreover, the categorisation of each technological innovation, whether it follows a technology-push or need-pull logic, an open or closed organisational approach, and which inefficiencies or complexities it addresses, is based on the researcher’s interpretation of publicly available information. These classifications are not claimed as internal factual statements about the companies, but as analytical assessments derived from observable indicators such as external communications, strategic announcements, partnership disclosures, technology descriptions, and stated customer-oriented objectives. The identification of inefficiencies and complexities is also grounded in the framework developed in Chapter 2, which synthesises the most recurrent in last-mile grocery logistics. The cases of Mercadona and Carrefour are therefore interpreted through this conceptual lens, allowing the researcher to align empirical observations with established categories in the literature.

The structure of the thesis follows a general to specific logic. Chapter 2 sets the scene by reviewing existing literature on digital transformation in retail logistics, and more specifically last-mile delivery. This provides the necessary conceptual understanding of the technologies and innovations currently being deployed in the sector, and why they matter for last-mile operations. Also it explains the most common inefficiencies and complexities in last-mile delivery.

Chapter 3 introduces the approaches, Organising for Innovation and Sources of Innovation, which will later be used to classify and interpret the technological innovations identified in the cases. These frameworks directly support the analysis in Chapter 5 and are essential for answering the second sub-research question, and therefore the general research question.

Chapter 5 then applies these concepts to the empirical material. It identifies the specific technological innovations used by Mercadona and Carrefour in the last-mile and interprets each innovation in terms of its source (need-pull vs technology-push) and organisational approach (open/closed, centralised/decentralised). A comparative section at the end of Chapter 5 synthesises similarities and differences across the two retailers.

Finally, the research questions are explicitly answered in the discussion (Chapter 6).

4.2. Data collection and analysis

This thesis seeks to answer the guiding research question: *"How can large grocery retailers implement digital transformation strategies, through technological innovations, that address the inefficiencies and complexities in last-mile delivery?",* by answering two questions related to the case studies and the approaches proposed:

"What technological innovations within last-mile delivery have Mercadona and Carrefour implemented to address the inefficiencies and complexities?"

and

"How do the organising and sourcing approaches to innovation influence the way these technological innovations address inefficiencies and complexities in last-mile delivery?"

The study aims to explore how companies in the grocery retail sector leverage digital transformation in logistics, specifically in last-mile delivery, and how such innovations can be categorised under the lenses of need-pull and technology-push, and open and closed innovation.

Initially, the research design included interviews with industry professionals to gather direct insights. However, due to limited access to relevant participants, the study was refocused exclusively on an in-depth qualitative case study approach based on secondary data sources.

The data collection was conducted in two stages. First a Literature review (Chapters 2 and 3), this stage developed the conceptual foundation on digital transformation, last-mile logistics, inefficiencies and complexities, and approaches for innovation. Secondly, Case study evidence gathering, focusing specifically on Mercadona and Carrefour, in Chapter 5. The literature review and case analysis followed established guidelines for evidence-based synthesis in innovation and management studies, particularly those of Grant and Booth (2009) and Kitchenham & Charters (2007). The process consisted of the following steps:

1. **Database search and keyword strategy:**

   For the literature review, the literature was sourced from Google Scholar, ScienceDirect, and ResearchGate. Keyword combinations included: *"digital transformation AND retail logistics"*, *"last-mile delivery AND innovation"*, *"need-pull innovation"*, *"technology-push innovation"*, *"open innovation logistics"*, *"closed innovation" "organising for innovation"* and *"sources of innovation"*.

   For the case studies, secondary data on Mercadona and Carrefour was collected from their corporate websites, press releases, annual reports, and sustainability reports. These sources provided direct evidence on the companies' digital initiatives, particularly those related to last-mile delivery. The search for the sources was guided by an inductive keyword-based approach. Press releases, corporate statements and newspaper articles were included only if they contained references that were related to digital transformation in last-mile delivery. The keywords used to identify relevant case material were aligned with the research question, more concretely with technological innovations, examples include: *app / online / home delivery / Drive / Click&Collect / fulfilment centres / warehouse automation / route optimisation / predictive demand / inventory algorithm / last mile / delivery platform / technology provider/ collaborations.*

2. **Inclusion and exclusion criteria:**

   For Literature: Inclusion criteria required **peer-reviewed** publications, in **English or Spanish**, and directly related to **digital transformation in logistics, last-mile delivery,** or the **approaches to innovation**. Excluded were articles without full-text access, non-peer-reviewed or unrelated to logistics/innovation strategy.

   For case studies: Selected documents had to explicitly reference **last-mile delivery, or digital transformation initiatives** of Mercadona and Carrefour. General corporate communication without logistics relevance (HR policies or branding campaigns) was excluded.

These criteria were used to filter an initial search result of documents to a manageable subset of relevant articles, reports, and corporate documents.

3. Study selection and screening:

For the literature review, all sources were logged into an **Excel spreadsheet** (seen in Appendix A) with metadata (title, author, year, link, inclusion status). Screening involved title/abstract checks, followed by full-text evaluation. Selected sources were mapped to conceptual categories: last-mile delivery, technology, sources of innovation or organising for innovation.

For Mercadona and Carrefour, an **Excel of initiatives** (seen in Appendix B) was created (including company, source, type of innovation, and relevance). Corporate documents and media articles were screened and classified according to the specific technological innovation they referred to (app, fulfilment centre, delivery model, predictive algorithm). Only those sources that referred to a concrete technological solution used by the retailer in the execution of last-mile delivery were retained. Articles that mentioned logistics in general terms, but did not describe a specific digital tool, were excluded.

At this stage, the classification was descriptive only. No labels relating to need-pull, technology-push, open or closed innovation were assigned, since companies do not explicitly communicate such orientations. These dimensions were only interpreted afterwards in the analysis chapter.

Importantly, the inefficiencies and complexities addressed by each innovation were not used as inclusion criteria during the screening stage. These links were identified after the analysis of each innovation and interpreted by the researcher based on observation and the literature in Chapter 2. The researcher therefore does the categorisation of inefficiencies and complexities by intended effects that each technology has, this is shown in Figures 7 and 11. In this way, the mapping between each innovation and the specific last-mile inefficiencies and complexities it addresses, emerged from the analysis, not from the initial selection criteria. Once this was done, the technological innovations were analysed through the lenses of the two approaches for innovation (sources of innovation and organising for innovation), based on researchers' interpretation of the data.

4. Data extraction and synthesis:

For the literature review, all selected academic and industry sources were analysed thematically. The aim was to extract the key concepts relevant to this thesis, including last-mile inefficiencies and complexities, technological enablers, and the innovation approaches later used in the case analysis. This synthesis informed the construction of Chapters 2 and 3.

For the case analysis, the selected documents (reports, press releases, corporate statements and specialised news articles) were reviewed. Each source was examined to identify technological innovations, implementation details, partnerships, and stated objectives. This stage remained purely descriptive. The classifications into technology-push or need-pull, and open or closed innovation were applied only afterwards, based on the researcher's interpretation of observable indicators.

5. **Reporting and framework:**

The findings from the literature review are presented in Chapters 2 and 3, whereas the empirical case material for Mercadona and Carrefour is presented and analysed in Chapter 5. The discussion and conclusions in Chapter 6 integrate both sets of results in order to answer the general research question and the sub questions.

This structure means that the descriptive categorisation of innovations Mercadona and Carrefour case analyses and the observed inefficiencies and complexities, enables the answer to sub question 1, while the conceptual lenses introduced in Chapter 3 are applied in Chapter 5 to interpret the origin and organisational form of those innovations, enabling the answer to sub question 2, and therefore with this two answers, the general research question can be addressed.

4.3. Validity and Reliability

Ensuring the validity and reliability of the data is essential to demonstrate the validity and credibility of the study. The value of the research is closely tied to the robustness of the methods used and the accuracy of its findings. Since the research relies exclusively on secondary data sources, such as academic literature, company reports, and press releases from Mercadona and Carrefour, the accuracy of the findings depends on the systematic and transparent handling of the data. Therefore, the validity and reliability of the secondary data directly influence the degree of acceptance of the research outcomes (Bekmezci & Sürücü, 2025). While these two concepts are often related, they refer to different aspects of research quality.

Reliability concerns the consistency or stability of the data over time (Bekmezci & Sürücü, 2025). In qualitative research, this means that the results are coherent with the collected data (Bekmezci & Sürücü, 2025). The consistency of this data and obtaining identical outcomes is a challenging thing due to the qualitative nature of the study, where there can be different interpretations to the same data. Although replication is challenging due to interpretive variation, reliability was strengthened through transparent inclusion and exclusion criteria in both the literature review and the case study material. All relevant corporate documents (press releases, corporate websites, annual reports) were collected and logged without selectively excluding information, strengthening interpretive consistency.

Validity refers to the extent to which a measurement tool accurately captures the intended concept and assesses its effectiveness in fulfilling its purpose (Bekmezci & Sürücü, 2025). It reflects whether the interpretations and conclusions genuinely represent objective reality (Bekmezci & Sürücü, 2025). Given that this thesis is based on content analysis, data triangulation was initially intended as a strategy to strengthen validity, combining corporate reports, press releases, media articles, and academic literature. However, during the process of data collection, the researcher realised that most media articles, newsletters and news items were themselves derived directly from corporate press releases. In practice, this means that the "triangulation" of secondary data largely reflected variations of the same corporate narrative, rather than independent viewpoints. This introduces a bias, as firms strategically communicate successes, and are less transparent regarding failed experiments or projects that did not scale. This limitation is therefore explicitly acknowledged. The researcher attempted to mitigate the risk of biased interpretation by searching for contrasting accounts when available, and by complementing corporate communication with academic literature when discussing inefficiencies and complexities. Nevertheless, it should be recognised that the data available for the case studies does not represent fully independent perspectives. Therefore, the validity of interpretations depends on careful cross-checking, rather than on genuinely independent data sources.

Transparency also requires acknowledging some other limitations. Because both Mercadona and Carrefour publish limited information on the internal organisation of innovation processes, it is not possible to directly determine whether specific practices are formally open/closed, centralised/decentralised or push/pull. This is a limitation of secondary data and constitutes a validity constraint, the available material does not perfectly address the approaches of Chapter 3. Therefore, the classification of innovations by approach (open/closed/centralised/decentralised/push/pull) in Chapter 5 is an interpretative step made by the researcher, grounded in the observed attributes of each innovation and the company, not stated by the companies themselves. This limitation is explicitly acknowledged in the interpretation.

In qualitative research, the concept of **trustworthiness** is fundamental. It refers to the overall quality of the research, evaluating whether the findings and interpretations are derived from a systematic process and can be considered reliable (Bekmezci & Sürücü, 2025). In this study, the literature review relied on peer-reviewed academic articles and institutional sources (academic journals, university repositories, industry studies). This strengthens trustworthiness because these sources are academically validated and transparent.

For the case studies, the sources consist mainly of company reports, press releases and sector specific media (newsletters, specialised press). These sources provide information about current initiatives, but they also introduce bias, since companies communicate selectively or emphasise successful initiatives.

To further assess the trustworthiness of the data, the framework proposed by Lincoln and Guba, which consists of four key criteria: credibility, dependability, confirmability, and transferability, has been adopted (Bekmezci & Sürücü, 2025):

- **Credibility** refers to strategies that confirm the accuracy and dependability of the research findings. These include prolonged engagement, persistent observation, triangulation of sources and theories, peer debriefing, referential adequacy, negative case analysis, and member checks (Bekmezci & Sürücü, 2025). In this thesis, credibility is supported through systematic documentation of the data collection process and through cross-checking information across multiple secondary documents (press releases, corporate reports and media). However, as acknowledged earlier, these sources are not fully independent, many media articles reproduce company press releases, which means that the researcher cannot ensure full objectivity. Therefore, credibility is treated cautiously, the analysis prioritises consistency across sources, and interpretations were developed with awareness of the bias present in corporate communication.

- **Dependability** assesses whether the study could yield similar results if replicated. In qualitative research, differing interpretations of the same data are common, and absolute replication is not always expected (Bekmezci & Sürücü, 2025). Nevertheless, dependability remains relevant through transparent documentation of the research process (Bekmezci & Sürücü, 2025). This is enhanced by the transparent documentation of the data collection process (outlined in Section 4.2), allowing readers to follow the methodological steps and understand how sources were selected and analysed.

- **Confirmability** addresses the objectivity of the findings and whether the research was conducted without bias. This requires that interpretations be grounded in the data and that the original sources be traceable. Confirmability is reinforced through systematic documentation, auditing, triangulation, and reflexive journaling (Bekmezci & Sürücü, 2025). In this thesis, confirmability is reinforced through the systematic documentation of all retrieved sources, stored with links and metadata. However, given that much of the case material originates from company press releases and media reproducing those releases, full objectivity cannot be claimed. Additionally, the categorisation of innovations into push or pull and open or closed is interpretive, as companies do not explicitly state these orientations. Therefore, the researcher acknowledges that confirmability is constrained by both the bias of corporate communication and the interpretive nature of the analytical categorisation.

- **Transferability** refers to the extent to which the findings can be applied to other contexts (Bekmezci & Sürücü, 2025). This is facilitated by providing rich contextual descriptions of both case studies, enabling readers to assess whether the insights on digital transformation in grocery retail logistics are applicable to other firms, sectors or country.

By applying these measures, and by explicitly acknowledging the limitations associated with corporate and media sources, the study aims to present findings that are methodologically robust, transparent and trustworthy, contributing to a better understanding of how digital transformation is unfolding in last-mile delivery in the Spanish grocery retail sector. However, it should also be acknowledged that, because the analysis is based exclusively on publicly available secondary data, some dimensions, particularly those related to organisation of innovation and sourcing of innovation, cannot be directly observed but must instead be interpreted. Therefore, the classifications presented in Chapter 5 (open or closed, push or pull, centralised or decentralised) reflect researcher assumptions based on patterns in the data, rather than official company statements.

Finally, this interpretive nature also applies to the identification of which inefficiencies and complexities each innovation addresses. Companies do not explicitly communicate the specific inefficiencies or complexities it solves. Instead, these links were derived analytically, combining company reported functionalities with the literature review in Chapter 2, to infer which inefficiency or complexity each technological solution responds to. This means that the thesis interprets what can be concluded from available evidence.

4.4. Limitations

This thesis faces several limitations that must be acknowledged. The study relies exclusively on secondary data sources, such as academic literature, company reports, press releases, and media articles. While this approach allows for a wide-ranging collection of information, it also introduces constraints related to data accuracy, completeness, and bias. Corporate communication, especially press releases, tend to emphasise successes and strategic positioning, while negative outcomes, operational failures, or discontinued initiatives are rarely reported. Since many case sources are company press releases or non-peer-reviewed media, these cannot be considered fully validated data.

Another limitation that derives from the bias of company-controlled communication is that since much of the available material originates from corporate press releases, media reproductions of those press releases, and official company reports, not all innovation initiatives, ongoing experiments, R&D operations or collaborations are publicly disclosed. Consequently, the analysis is based on a partial representation of the companies' innovation portfolios. This means that when the researcher assumes whether a given innovation is more likely to be technology-push or need-pull, or whether it reflects an open or closed organisational configuration or a centralised or decentralised structure, those classifications may be incomplete or misaligned with internal realities that remain non-public.

The original research design intended to incorporate interviews with logistics and innovation professionals. However, difficulties in securing access to participants led to the exclusion of this component. As a result, the study lacks direct insider perspectives that could have enriched the analysis of last-mile delivery strategies with practical, real-world insights.

The thesis analyses two case studies, Mercadona and Carrefour, which limits the generalisability of its findings. Although these companies are among the largest grocery retailers in the Spanish market, and provide rich and contrasting examples, the conclusions may not fully apply to smaller retailers or to firms operating in other contexts.

Digital transformation in retail logistics is an evolving phenomenon. The rapid pace of technological development and shifting consumer behaviours mean that strategies adopted by Mercadona and Carrefour may quickly change. Consequently, the study offers a snapshot in time rather than a definitive account of long-term outcomes.

Despite these limitations, the study contributes meaningful insights into how large grocery retailers approach digital transformation in last-mile delivery. By explicitly stating its boundaries, the thesis preserves analytical transparency and provides a basis for future research including primary data collection, more cases, or longitudinal comparison.

4.5. Future research

The limitations outlined above open avenues for future research that could complement and extend the findings of this thesis. Future studies could integrate interviews or surveys with managers or logistics operators to capture insider perspectives. This would provide a richer understanding of the decision-making processes behind digital transformation strategies and validate whether official narratives align with operational realities.

Including additional grocery retailers, particularly small- and medium-sized firms or players operating outside the Spanish context, could improve the generalisability of results. Comparative studies across different regions would also help assess how context shape innovation trajectories in last mile.

While this thesis takes a qualitative approach, future research could employ quantitative methods to complement the interpretive classification into need-pull/technology-push and open/closed innovation models with measurable outcomes. Finally, further research could explore additional approaches to expand beyond the sources and organisation of innovation.

5. Analysis

This chapter presents the analysis of the two case studies: Mercadona and Carrefour, with the aim of responding to the research question guiding the thesis. The first part of the chapter acts as a brief contextual introduction to frame the cases, and the analytical interpretation begins explicitly in Section 5.1 (Mercadona) and Section 5.2 (Carrefour).

The analysis investigates how both companies have implemented digital transformation in their last-mile strategies to address the inefficiencies and complexities that characterise this critical part of the logistic chain. Furthermore, this research classifies the identified innovations according to their source (need-pull or technology-push) and the organisational approach adopted by each company (open or closed) to analyse how innovation is structured within Mercadona and Carrefour.

Before proceeding with the case analysis, it is necessary to clarify how this thesis interprets inefficiency, complexity, and effectiveness in last-mile delivery. In this study, inefficiency refers to misallocation of the resources in the delivery process, such as unnecessary cost, time, distance travelled, labour or stock movements, viewed from both the firm and the customer perspective. From the firm side it could be referred to picking in store is slow, long routing distances or inactive fleet. From the customer side it could be referred to long waiting time, low delivery flexibility or a difficult ordering interface.

Complexity refers to structural difficulty in the logistics system caused by interdependence (multiple actors, nodes and handovers) and variability (especially the unpredictability and perishability characteristic of groceries). Effectiveness is understood as the extent to which a given innovation addresses identified inefficiencies or complexities.

It is important to clarify that the categorisation of inefficiencies and complexities presented in this section is based on observation of intended effects rather than on explicit company disclosures. The classification reflects the researcher's interpretation of the effects of each technological innovation, as observed through secondary sources. These interpretations are therefore linked to the literature in Chapter 2 for last-mile delivery, illustrating how each innovation appears to address inefficiencies and complexities.

The findings are based exclusively on secondary sources, as mentioned in Chapter 4. These include press releases, company reports, and official websites, which were previously categorised in the Excel database (Appendix B) described in the methodology section.

The chapter is structured as follows: first, Mercadona's digital transformation innovations are analysed (5.1), then Carrefour's (5.2). After these individual analyses, a comparative section synthesises the findings of both cases. Finally, Chapter 6 builds on this comparative view to answer the research questions.

As discussed in the literature review, last mile is undergoing a deep digital transformation within the retail sector, particularly in the grocery industry. The rise of e-commerce, increasing customer expectations for fast, convenient, and flexible delivery, and growing sustainability concerns have force retailers to develop digital strategies that address these demands. The dominant technologies driving this transformation include Artificial Intelligence (AI), automation, robotics, data analytics, and the Internet of Things (IoT). Through these technologies, strategies such as advanced routing algorithms, autonomous vehicles, and micro-fulfilment centres have been introduced to tackle the inefficiencies and complexities of last-mile delivery.

The following sections therefore show, case by case, how Mercadona and Carrefour have leveraged these technologies to transform last-mile delivery and how these innovations can be interpreted through the approaches introduced in Chapter 3.

5.1. Mercadona

Mercadona is one of the largest supermarket chains in the Spanish retail market. As introduced in Chapter 1, the company has consistently demonstrated a strong commitment to digital transformation and operational excellence, making technology a core element of its business strategy.

One of the company's value proposition pillars refers to developing "*high-impact projects based on cutting-edge technology*" (Mercadona, 2025). To fulfil this objective, Mercadona established Mercadona IT, the division responsible for leading the company's digital transformation. Mercadona IT is composed of approximately 1,200 professionals who design, develop, and manage large-scale projects aimed at modernising the company's technological infrastructure (Mercadona, 2025). Their work covers a broad range of operations, from product design and store logistics to supply chain optimisation, ensuring that all business units benefit from integrated digital solutions (Mercadona, 2025). This department collaborates closely with operational teams to identify process inefficiencies and implement digital tools that enhance internal workflows, optimise decision-making, and improve the overall customer experience (Mercadona, 2025).

In recent years, Mercadona, as they stated in a press release, has reinforced its digital excellence strategy through an investment of €250 million dedicated to expanding and modernising Mercadona IT (Mercadona, 2025). This investment supports the re-engineering of legacy systems, the acceleration of digitalisation projects, and the development of new solutions to meet emerging business needs (Mercadona, 2025). Through partnerships with global technology leaders and sector experts, Mercadona ensures continuous technological upgrading and knowledge transfer across its teams (Mercadona, 2025).

Complementing this internal transformation, Mercadona launched Mercadona Tech in 2016, a specialised division dedicated to e-commerce and digital innovation, with Tech Hubs in Valencia and Madrid (Mercadona Tech, n.d.). The initiative, as they have it in their website, was designed to transform the online shopping experience by offering customers a simple, intuitive, and efficient digital platform, fully aligned with the company's value chain and logistics-oriented philosophy (Mercadona Tech, n.d.).

Mercadona Tech integrates technology and operations to streamline warehouse activities and optimise logistics processes through the development of proprietary digital tools (Mercadona Tech, n.d.). The department is structured into multiple multidisciplinary teams: three focus specifically on e-commerce platforms, whereas the remaining teams are dedicated to logistical operations, including warehouse supply, order preparation, dispatch, and last-mile distribution (Mercadona Tech, n.d.). This organisational setup ensures that innovation processes are centrally coordinated within the company, allowing Mercadona to maintain strategic control over technological development and data management (Mercadona Tech, n.d.).

These two divisions operate as the company's internal R&D units and are responsible for the development and integration of digital tools across the organisation. In the context of last-mile logistics, these departments are assumed to develop the technological innovations for the company. They appear to be the main internal mechanism through which Mercadona develops digital initiatives that have implications for last-mile performance.

5.1.1. Technological Innovations in Last-Mile Delivery

Mercadona has implemented several innovations within its last-mile delivery system, developed primarily through their internal R&D departments. Mercadona Tech, together with Mercadona IT, coordinate all technological projects within the company and represent a major investment in the digitalisation of e-commerce and logistics operations. Mercadona Tech affirm in their website that their main role is to integrate technology and operations, facilitating the work of the company's logistics centres and fulfilment hubs, while optimising supply chain processes through internally developed digital tools (Mercadona Tech, n.d.).

The digital transformation in Mercadona, has been guided by the next innovations:

1) **Mercadona Online and App**

Describing the innovation

As Mercadona collected in their Annual Report from 2018, in this year they launched the Mercadona Online platform and mobile application, marking a decisive step in the digitalisation of its last-mile operations, according to Mercadona "*Today we are no longer just a physical supermarket company, we are also becoming an online supermarket company, following the launch of the Mercadona Online project*" (Mercadona, 2018). Mercadona Online substituted the previous webpage that they had until then. Mercadona stated that this online platform initially was available in a limited number of Spanish cities and with a minimum purchase requirement of €50, the new platform represented a complete redesign of the company's online service (Mercadona, 2018). According to the Spanish newspapers of *El Español* and *Economía Digital*, this app features a more intuitive interface, simplified navigation, and an improved purchasing experience, developed through co-innovation processes with customers (Economía Digital, 2018; Fernández, 2020)

These newspapers also refer to the launch of a new e-commerce website, integrated with the mobile app, allowing customers to shop online through a unified, seamless experience (Economía Digital, 2018; Fernández, 2020). Together, these developments marked the foundation of Mercadona's last-mile digital strategy, aimed at offering fast, convenient, and flexible home delivery.

The Spanish newspaper *El Español*, tried the app and their functionalities where they discovered that the Mercadona App mirrors the in-store experience, according to them "*Just like a physical supermarket, the app/website has a categories section so you can see all the products*", enabling customers to browse products by category, access detailed product information, and view prices (Fernández, 2020). The author stated that one of its key features is the inclusion of high-resolution product images that allow users to zoom in on labels to check nutritional values, ingredients, and allergens, replicating the transparency and familiarity of a physical store visit (Fernández, 2020).

Economia Digital talks about the app going beyond digital convenience, employing data analytics and artificial intelligence (AI) to personalise the shopping experience, "*the more the customer uses the app, the better their experience will be, with a section for frequently used products and recommendations*", so when customers make repeat purchases, the system collects behavioural data to generate personalised recommendations, automatically suggest frequently purchased products, and predict order quantities based on past shopping patterns (Economía Digital, 2018). This data-driven functionality demonstrates Mercadona's capacity to use machine learning algorithms to enhance user engagement and streamline the purchasing process.

Additionally, *Economia Digital* talks about the integration in the app of AI-powered chatbots, available daily between 7:00 and 23:00, to support real-time customer interaction and resolve queries, further improving service responsiveness and user satisfaction (Economía Digital, 2018).

Technologies applied

The Mercadona Online platform and mobile app integrate a set of digital technologies designed to enhance personalisation, navigation efficiency, and customer interaction. The system employs **data analytics** and **machine learning** algorithms to analyse purchase behaviour, generate personalised product lists, and suggest frequently bought items. **Artificial intelligence** is incorporated through recommendation engines and AI-powered chatbots, which support real-time customer assistance throughout the ordering process.

Together, these technologies enable a seamless, data-driven customer journey and support the digitalisation of Mercadona's last-mile operations.

Effects

Based on the inefficiencies and complexities defined in Chapter 2 and observation from the researcher, Mercadona Online & App address inefficiencies related to ordering friction and digital accessibility. The redesign of the interface simplifies browsing, reduces check out time and enhances usability, lowering the time cost associated with placing and order.

Sourcing and Organising for Innovation

Mercadona Online and app is interpreted as a primarily **need-pull**. This categorisation is based on the strong indication that this originated from customer demands for convenience, flexibility, and digital accessibility, which prompted the company to modernise its e-commerce operations. According to the newspaper *Las Provincias*, the app "*is the result of co-innovation with clients… tests have been made with them to know their needs and learn about their experience*" (Europa Press, 2019). The redesign of Mercadona's digital interface and ordering process responded directly to usability gaps, negative feedback on the previous platform, and the increasing expectations for seamless digital grocery experiences. According to Juan Roig, the CEO of Mercadona, the previous webpage "*was really bad, that is what the clients say and me too*" (Gimenez, 2017). These factors indicate that the initiative was primarily motivated by perceived consumer needs rather than by the availability of a new technology.

However, even though some co-innovation occurred with clients the development and deployment of the platform were carried out internally by the R&D departments where it is interpreted that it reflects a mix between **open** and **closed** organisational structure. The technologies applied, AI, data analytics, and automation, were developed or integrated within Mercadona's internal systems, ensuring full control over user data and service performance. This combination of customer-driven need-pull logic and internally governed innovation exemplifies how Mercadona strategically balances responsiveness to market demands with the protection of its digital ecosystem.

2) **Fulfilment centres "Colmenas"**

Describing the innovation

Another of Mercadona's most relevant innovations in last-mile delivery is the implementation of the "Colmenas", these are automated fulfilment centres distributed across several Spanish cities. As Mercadona stated in their Annual Report from 2021, the Colmenas are "*warehouses dedicated exclusively to online orders with the aim of optimizing and streamlining both preparation and delivery, resulting in improved productivity and time savings"* (Mercadona, 2021).

Additionally, Mercadona states that they have develop the “Nueva Telecompra”, a model that will allow “*to meet the needs of online customers in areas with lower order density, where the store is sufficient to cover that demand*”, the online orders are prepared directly from physical stores (Mercadona, 2021). This can generate congestion, inefficiencies, and stock discrepancies between online and offline channels.

But as the newspaper *Valencia Plaza* mentions in their article, these Colmenas are dedicated facilities where orders are processed in batches, typically between eight and ten at a time, allowing greater efficiency, productivity, and accuracy in fulfilment, they reference Álvaro Vila, Process Coordinator at the Colmenas that said: "*we have realized that, by preparing orders in batches of eight or ten, we are more productive than one by one*". (Pastor, 2023).

The newspapers of *Valencia Plaza* and *El Economista* affirm that these fulfilment centres are equipped with internally developed hardware and software systems that guide employees during the picking process, indicating which products to select and confirming that they are placed in the correct batches (Pastor, 2023; El Economista, 2020). The newspapers ensure that this system dynamically manages the product layout, “*to try to leave the lower shelves empty so that order pickers don't have to bend down to put them in*”, to minimise physical strain and improve ergonomics (Pastor, 2023). *El Economista* and *Valencia Plaza* affirm that these warehouses, lithium-powered pallet trucks and automated lifting systems are used to facilitate handling and reduce preparation time (Pastor, 2023; El Economista, 2020). Furthermore, Mercadona in their Annual report (2021) say that they employ “*gas-powered vehicles that can transport up to 15 orders and have been exclusively designed with three temperature zones adapted to each type of product”* (Mercadona, 2021).

El Economista affirms that “*all the software used in the different processes is developed internally by Mercadona, which has a team of developers, product managers, and designers”*, this software used in these facilities manages the entire operational process, from inventory replenishment to last-mile routing (El Economista, 2020). *Valencia Plaza* says that the trucks that transport online orders are equipped with a “*route optimization software for orders, as explained by Javier Herraiz, delivery fleet coordinator*”, this AI-based route optimisation software and mechanised unloading systems minimises handling time and energy use (Pastor, 2023). In the Annual Report (2021) Mercadona states that this not only improves delivery effectiveness but also aligns with Mercadona’s sustainability strategy by reducing emissions using natural gas vehicles (Mercadona, 2021).

Technologies applied

The Colmenas integrate a combination of digital and automated technologies that enable effective preparation of online orders. These facilities rely on **automation and robotics** to support batch picking, assisted by internally developed **warehouse management software** that guides employees through optimised picking routes and dynamically adjusts product layouts. The system incorporates **IoT** and **AI-based tools** route optimisation. Additional technologies such as mechanised lifting equipment and multi-temperature loading systems support ergonomic handling and correct preservation of perishable items.

Effects

Unlike traditional in-store picking, where online orders are prepared in the same space as physical customers, the Colmenas remove online demand from stores and centralise preparation in a logistics node dedicated exclusively to e-commerce. According to last-mile literature, in-store picking is characterised by low picking productivity, aisle congestion and significant labour and scheduling. By batching orders (8–10 at a time) and specialising workers in picking only, Colmenas intend to address these inefficiencies by increasing pick-rate per labour hour and eliminating interference between online and physical flows.

From a complexity perspective, grocery online is characterised by high product variability, different temperature regimes (fresh/chilled/frozen) and short replenishment cycles. Colmenas address these interdependencies in a controlled environment, with dedicated zones, internal software and lifting equipment. This intends to address the coordination complexity that arises when a store must simultaneously serve walk-in customers, pickers and restockers.

Sourcing and Organising for Innovation

This initiative is categorised, according to the researcher's interpretation, as a **technology-push innovation**. The classification is based on the assumption that the development of the Colmena model originated from technological advancements in warehouse automation, digital inventory management, and fulfilment design, which enabled Mercadona to establish a dedicated network for online order processing. Rather than emerging as a direct response to explicit market or customer demands, the company leveraged these internal technological capabilities to reconfigure its logistics architecture and address inefficiencies and complexities.

Although Colmenas contribute to reducing last-mile inefficiencies and complexities and can be seen as responding to an internal organisational need to improve effectiveness, this need does not stem from market demand, as the same service could theoretically have been provided through in-store picking. Therefore, the initiative reflects an internally initiated innovation driven primarily by technological opportunity, characteristic of a push-oriented development logic.

From an organisational perspective, the researcher interprets this as a **closed innovation model**, since all systems and tools have been developed internally by R&D departments, without external collaboration. This reinforces the company's strategic autonomy and control over the innovation process while ensuring that technological developments remain closely aligned with its operational objectives.

3) In-house delivery fleet

Describing the innovation

Mercadona operates an entirely in-house delivery fleet. They maintain full control over its distribution operations through a centralised system. This strategic choice allows the company to ensure consistent service quality, maintain control over sensitive delivery data, and coordinate routes directly from the Colmenas.

In a press release in February of 2020 Mercadona reported that they introduced an important innovation in its last-mile logistics through the implementation of "*electric truck transport at 3 temperatures"* which *"represents a great innovation that improves quality and sustainability in home delivery*", this fleet of multi-temperature delivery vehicles is designed to ensure product integrity during urban distribution (Mercadona, 2020). These vehicles, developed in collaboration with a technology partner, Thermo King, and Maxus are specifically equipped with three temperature zones: ambient, refrigerated, and frozen, enabling the simultaneous transport of different product categories while maintaining quality and freshness, as this company stated in their website, the truck "*combines the Maxus electric truck with the Thermo King multi-temperature unit capable of cooling and maintaining the set temperature levels of the vehicle's three compartments for fresh, frozen and dry products"* (Thermo King, 2019). This system is particularly relevant for grocery delivery, where perishable goods require strict temperature control to prevent spoilage and guarantee food safety.

In addition, in another press release in September of 2020, Mercadona stated that these vehicles are part of Mercadona's broader sustainable transport strategy, which prioritises the use of cleaner technologies such as natural gas and electric propulsion to reduce emissions and adapt to urban low-emission zones (Mercadona, 2020). They affirmed that "*Logistics optimization is one of the fundamental pillars of Mercadona's environmental protection policy. The goal is to "transport more with fewer natural resources," committing to sustainable transport that allows them to maintain logistical excellence with the least possible environmental impact*", the trucks also feature mechanised unloading systems that minimise manual handling, reduce worker effort, and shorten unloading times (Mercadona, 2020).

Additionally, the trucks incorporate WiseTrace's sensors to digitally monitor the refrigerated vehicle and "*guarantee traceability and maintenance of the cold chain in the logistics fleet*" (WiseTrace, n.d). They explain that the solution "*allows for the centralized management of refrigerated vehicles and the sending of real-time alerts to prevent breaks in the cold chain, combining traceability, remote control, and energy efficiency on a single platform*" and enabling immediate corrective action and preventing spoilage (WiseTrace, n.d). As they ensure, the outcome is a more intelligent, automated, and energy-efficient logistics network, capable of turning data into actionable decisions and enhancing both sustainability and reliability across Mercadona's supply chain (WiseTrace, n.d).

Technologies applied

Although detailed public data on Mercadona's internal logistics software is limited, the company's focus on maximising transported goods while minimising trips and resources, strongly suggests the use of **AI-based routing** and **optimisation algorithms**. The newspaper *Valencia Plaza* affirms that Mercadona´s trucks have a software for optimising routes (Pastor, 2023). These systems likely analyse variables such as traffic conditions, delivery density, time windows, and vehicle capacity to determine the most efficient delivery routes. This aligns with the company's broader strategy of **data-driven logistics** and **machine learning** integration to reduce fuel consumption, optimise delivery times, and enhance productivity.

Wisetrace's company's website ensures that the sensors that they have implemented, incorporate an **AI** and **IoT** based platform that allows real-time supervision of temperature, routes, and mobile assets (WiseTrace, n.d). WiseTrace's solution combines hardware and software technologies that facilitate centralised fleet management, remote device updates, and A-GPS optimisation to reduce energy consumption and maintenance interventions (WiseTrace, n.d).

Effects

Based on the literature in Chapter 2 and the researcher's observation, Mercadona's in-house delivery fleet addresses inefficiencies and complexities related to the physical hand-off to the customer. Fleet delivery inefficiency is referred to missed deliveries, time lost in routing, and food safety constraints that limit routing flexibility. Mercadona's own fleet address inefficiencies by controlling vans and drivers, where they do not depend on 3rd parties, integrating a multi-zone refrigeration that reduces product deterioration during routing, and by routing optimisation algorithms and batching. From a complexity standpoint, grocery is a temperature-segmented logistic problem (fresh / chilled / frozen). Maintaining multiple thermal zones during routing increases the interdependence between decisions (route, sequence, loading order). Mercadona's solution addresses that complexity by integrating sensors, routing optimisation and refrigerated compartments.

Sourcing and Organising for Innovation

According to the researcher's interpretation, Mercadona's in-house delivery fleet represents a **hybrid innovation**, combining both technology-push and need-pull dynamics. The technology-push dimension is reflected in the adoption of advanced routing algorithms, fleet management software, and multi-temperature delivery systems, enabled by emerging logistics technologies that allow Mercadona to address inefficiencies and complexities for last-mile delivery. At the same time, the initiative responds to need-pull forces derived from customer expectations for reliability, punctuality, and high service quality in grocery delivery. These expectations encouraged the company to develop a fleet capable of delivering orders as quickly as possible while guaranteeing product freshness and quality through the incorporation of innovative temperature-control solutions.

From an organisational perspective, the innovation follows a **mixed open and closed model**. The fleet is owned, developed, and managed internally by Mercadona, ensuring operational control and service consistency. However, the vehicles integrate technologies provided by external providers, such as routing optimisation and temperature management systems. This collaboration with specialised technology providers illustrates a partially open approach, allowing Mercadona to combine internal development with external technological expertise.

4) Predictive demand and inventory management

Describing the innovation

In the newsletter *Logispyme* they talk about the implementation of artificial intelligence (AI) systems in Mercadona, "*to improve your demand forecasting and inventory planning"* across its logistics chain, particularly for fresh and perishable products (López, 2025). The author affirms that the company's predictive model "*uses machine learning to analyze historical sales patterns, seasonal trends, and real-time data*" (López, 2025). *Logispyme* states that by "*integrating this data with external variables, such as weather and local activity, the algorithm adjusts demand forecasts for each store and produc*t" (López, 2025).

This newsletter refers to a distinctive advantage of Mercadona's AI-driven forecasting system that lies in its ability to "*manage the demand for perishable products, such as fruits and vegetables, which require constant and precise replenishment to avoid waste*" (López, 2025). The author reports that by predicting future demand more precisely, Mercadona has been able to significantly reduce food waste, ensure that fresh products arrive in stores at optimal times, and maintain consistent product availability (López, 2025). This predictive approach optimises replenishment orders and improves stock rotation (López, 2025). *Logispyme* concludes that as a result, transportation costs are reduced, product freshness is maintained, and warehouse operations become more responsive to actual market needs (López, 2025).

Technologies applied

Mercadona's predictive demand and inventory management system integrates several technologies that enable data-driven decision-making across the supply chain. These include **machine learning algorithms** for demand forecasting, **artificial intelligence (AI)** for real-time pattern recognition, and **big data analytics** to process sales, inventory, and external variables such as seasonality or regional demand fluctuations. Together, these technologies enhance forecasting accuracy, reduce waste, and optimise replenishment cycles.

Effects

As it was seen in Chapter 2, demand variability is an important inefficiency in grocery last-mile because perishability forces short replenishment cycles, which increases stockouts, overstock and waste. Based on observation, Mercadona's forecasting system tries to address inefficiencies such as, excess stock or stock-out at picking moment. This innovation addresses complexities related to synchronising demand fluctuation, replenishment decision and freshness constraints between Colmenas and stores. Improved demand prediction allows better coordination between preparation centres and delivery schedules, ensuring that perishable goods move through the network with minimal delay and maximum freshness.

Sourcing and Organising for Innovation

From the researcher's interpretation, this system exemplifies a **combination of technology-push and need-pull innovation**. The classification is based on two observable conditions. First, the technology-push dimension is assumed to arise from the availability and advancement of artificial intelligence (AI), machine learning, and big data analytics, which enabled the automation of forecasting and replenishment processes. These technologies create new possibilities for operational optimisation that the company adopted.

In addition, this innovation is interpreted to be a provider-driven need-pull dynamic. The development of predictive systems creates digital integration with suppliers and technology partners, who benefit from real-time visibility of inventory and demand data to coordinate production and replenishment. This can act as a complementary source of innovation, encouraging Mercadona to design interoperable data architectures and forecasting tools that facilitate collaboration while maintaining internal control over information flows.

Organisationally, this innovation is interpreted as reflecting a **closed** model of innovation, as the predictive algorithms and data platforms are developed and managed internally by Mercadona's R&D departments. This internal governance structure ensures alignment between technological development, operational performance, and the company's broader digital transformation strategy.

5.1.2. Approaches for Innovation

This subsection examines how Mercadona approaches innovation in relation to the technological innovations identified in the previous chapter. The aim is to analyse how they are sourced and governed. First, a table (Figure 6) will classify each innovation according to whether, from the researcher's assumptions, it appears to emerge mainly from technology-push or need-pull mechanisms, and whether its organisational form aligns more with a closed or an open innovation orientation. Second, another table (Figure 7) will summarise which inefficiencies and complexities of last-mile delivery each innovation addresses.

Innovation	Technology	Source	Approach	Collaboration

Mercadona Online	Machine learning, AI and data analytics	Need-pull	Closed + Open	Customers
App	Machine learning, AI and data analytics	Need-pull	Closed+ Open	Customers
Colmenas	Automation, AI, robotics, and IoT	Technology-push	Closed	-
Delivery fleet	AI, optimisation algorithms, data analytics, machine learning and IoT	Need-pull + Technology-push	Closed + Open	Technology providers
Demand prediction and inventory management	AI, machine learning and data analytics	Need-pull + Technology-push	Closed	-

Figure 6:Summary of Mercadona's Innovations

As illustrated in Figure 6, Mercadona's innovation process, particularly in the context of digital transformation in last mile, can be interpreted as a predominantly closed organisation, yet one that combines both technology-push and need-pull sources of innovation.

Regarding the **sources of innovation**, it is interpreted that Mercadona's digital transformation integrates elements from both models. **Need-pull innovation** is primarily driven by market demand, encompassing both customers and providers. Customers are assumed to play a stronger role in customer-facing innovations such as the online platform and mobile app, as well as the delivery fleet, since these directly determine the quality, speed, and reliability of the service that customers experience. In contrast, providers are assumed to play an important part in predictive algorithms and inventory systems, where integration with suppliers and technology partners are needs in regard to functional requirements and data-sharing.

The **technology-push** component is visible in innovations such as the Colmenas, the delivery fleet and the predictive demand systems, which emerged from technological opportunities in automation, robotics, AI, IoT and data analytics rather than explicit customer requests. These initiatives reflect Mercadona's internal capacity to identify, adopt, and implement emerging technologies to address inefficiencies and complexities.

This combination of push and pull dynamics can be understood at both the organisational and the innovation level with the **coupling model**. Following Rothwell's (1994) interactive or coupling model, innovation is not seen as purely technology-push or purely need-pull, but as the result of interaction between technological capabilities and market requirements within a single innovation process. In line with Maier, Ho & Branzei (2016), this interactive logic can also be observed at the organisational level, where firms combine different innovation logics across their portfolio, developing some innovations mainly through technology-push and others through need-pull. Therefore, Mercadona can be interpreted as applying the coupling model both at the innovation level, where certain projects integrate technology-push and need-pull dynamics, and at the organisational level, where the company combines purely need-pull, purely technology-push, and hybrid innovations within its digital transformation strategy.

Additionally, from the information publicly available, Mercadona appears to rely primarily on its internal R&D divisions, to design, develop, and implement the technologies embedded in its logistics network. These departments act as the strategic and operational core of innovation, ensuring that digital systems are closely aligned with corporate goals, operational coherence, and service quality. Therefore, it is assumed that Mercadona follows a **centralised** innovation model, although this interpretation is based on observable evidence rather than confirmed internal data.

With respect to the approaches to innovation, it is interpreted by the researcher that Mercadona exhibits a **predominantly closed** model. The development of core technological systems, warehouse management tools, routing algorithms, digital interfaces and internal software, is assumed to be carried out almost entirely within Mercadona's R&D departments. These internal divisions function as the central hub of the company's digital transformation, ensuring tight control over design, implementation and integration across the organisation.

Although Mercadona integrates some open innovation elements, from what is publicly available, these remain highly selective and strategically limited. Collaborations with external technology providers appear to occur only when highly specialised equipment or technical components are required. Examples include partnerships with WiseTrace for IoT temperature sensors or Thermo King for refrigerated vehicle systems. These forms of openness involve the acquisition or integration of external technologies rather than co-development or shared innovation processes.

Mercadona also engages customers in its innovation processes, this involvement appears to be more focused in feedback, rather than co-creation. Customer input is used to refine usability and service quality, yet the conceptualisation and development of innovations appear to remain internal.

Taken together, these characteristics support the interpretation that Mercadona follows a mostly closed innovation approach, complemented by limited and purpose-specific external collaborations. The company retains control over all core innovation activities, integrating external technologies only when necessary and ensuring that external contributions are embedded within a centrally governed digital ecosystem.

Innovation	Inefficiencies addressed	Complexities addressed

Mercadona Online and App	Ordering friction and time cost	-
Colmenas	In-store congestion, low pick rate and labour waste	Coordination between online and offline logistics and managing multiple temperatures
Delivery fleet	Transportation costs and inefficient routing	Maintaining temperature-sensitive logistics
Predictive demand and inventory management	Overproduction and stockout and inefficient replenishment cycles	Perishability-driven demand uncertainty and replenishment interdependence

Figure 7: Mercadona's Innovations and the inefficiencies and complexities it addresses

Figure 7 presents a summary of the main inefficiencies and complexities addressed by each of Mercadona's technological innovations. The table illustrates how each innovation targets specific inefficiencies and complexities within the last-mile logistics process. While some technologies, such as Mercadona Online and App, primarily focus on improving ordering frictions and customer experience, others, like Colmenas, the Delivery Fleet, and Predictive Demand and Inventory Management, tackle deeper logistical inefficiencies related to fulfilment, routing, and inventory coordination. This overview provides a clear link between the technological solutions analysed and the structural inefficiencies and complexities identified in Section 2.2.1.

In conclusion, Mercadona's approach to innovation in last-mile logistics reflects a structured yet flexible system that appears to be predominantly **closed** and is assumed to be **centralised**. The company develops and governs most technological solutions internally, while selectively collaborating with customers and specialised technology providers when external expertise is required. From the researcher's analytical perspective, Mercadona's digital transformation can be interpreted as following a **coupling model**, where technology-push and need-pull dynamics interact across both individual innovations and the organisation's broader strategy. This alignment illustrates a balance between control, collaboration, and responsiveness to market and provider needs.

5.2. Carrefour

Carrefour is an international supermarket brand with a strong presence in Europe, particularly in Spain, one of its key markets, coinciding with Mercadona. The company has positioned itself as one of the pioneers of digital transformation in the retail sector, implementing large-scale strategic plans such as Carrefour 2022 and the ongoing Digital Retail 2026 initiative. This strategy, launched in 2018, is guided by the motto "*data-*

centric, digital first", and aims to accelerate e-commerce growth, expand data and retail media activities, digitise financial services, and modernise traditional retail operations through advanced technologies (Carrefour, n.d). Carrefour's ambition is to transform itself into a fully Digital Retail Company, capable of operating as an integrated and omnichannel ecosystem (Carrefour, n.d).

Between 2022 and 2026, Carrefour plans to increase its investment in digital transformation by approximately 50%, with the objective of tripling its e-commerce Gross Merchandise Value (GMV). To achieve this, the group has defined four key strategic drivers: acceleration of e-commerce, data and retail media expansion, digitisation of financial services, and digital transformation of traditional retail operations. (Carrefour, n.d)

Carrefour seeks to strengthen its leadership in last-mile delivery through both express delivery (under three hours) and quick commerce (under fifteen minutes). This strategy is implemented in collaboration with delivery platforms such as Uber Eats and Glovo, which facilitate flexible, on-demand distribution in urban areas. Carrefour also aims to expand into non-food e-commerce segments through marketplaces, social commerce, and live shopping, reflecting the company's commitment to omnichannel retail. (Carrefour, n.d)

They aim to become a cloud-based company by 2026, which will increase system agility and reduce time-to-market for new digital services. Through AI-enabled data processing and automation, the company is transforming core processes such as pricing, assortment strategy, forecasting, logistics, and administrative workflows. This digitalisation enhances operational efficiency while improving customer experience through greater personalisation and service quality. (Carrefour, n.d)

Carrefour's digital transformation is complemented by an active commitment to open innovation. The company has established a Venture Capital Fund and a Corporate Innovation Studio to accelerate collaboration with startups and emerging technology providers. The venture fund invests in early-stage companies developing solutions for digital retail, with the goal of anticipating market disruptions and identifying future industry leaders. (Carrefour, n.d)

Through these different key initiatives, Carrefour's transformation also targets last-mile delivery activities. They are focusing on alliances, automation, AI, data analytics and platform-based collaboration to target inefficiencies and complexities in logistics and more concretely in last-mile.

5.2.1. Technological Innovations in Last-mile Delivery

Carrefour has an open and collaborative philosophy that is present in their last mile strategies. The main innovations that they have introduced as part of their digital transformation are:

1) Carrefour Online Platform & App

Describing the innovation

As part of its broader digital transformation strategy, Carrefour has developed its online platform and the My Carrefour App. Similar to Mercadona's initiative, this system enables customers to purchase groceries online while also offering a wide range of additional services that enhance the shopping experience. On its website, Carrefour defines the app as "*your app for everything, everything, everything,*" highlighting its multifunctional character (Carrefour, n.d.). Beyond online shopping, it integrates features such as digital coupons, savings checks, promotional brochures, and a digital loyalty card, which together contribute to a paperless, seamless, and customer-centric experience (Carrefour, n.d.). It can therefore be described as a complete integration between the website, app, and physical store, combining digital and in-store experiences into one system.

As described in *El Español* and *Inforetail*, the My Carrefour App offers numerous features that extend beyond the online grocery shopping experience. *El Español* highlights that "*Navigating the Carrefour app can be complicated at first due to the large number of options it offers*." (Araque, 2023), reflecting its wide functionality. These newspapers describe that on the main screen, users can find direct access to the weekly catalogue, the last store visited, the "Cheque Ahorro" (savings check) where discounts accumulate for future purchases, and the digital *Club Carrefour* card displaying both the identification number and barcode (Inforetail, 2019; Araque, 2023). The app also enables users to scan QR codes in-store to check product prices and information, further reinforcing the connection between digital and physical retail environments (Inforetail, 2019; Araque, 2023).

This app, has been developed in collaboration with other companies and technology providers that have helped them structuring the app. The company O2O, has developed some solutions for Carrefour, according to this company, "*…it was very important for Carrefour to integrate and improve its sales channels, ensuring a consistent and satisfying customer experience. Furthermore, the company sought to excel in the field of digital innovation, not only to meet evolving consumer needs, but also to anticipate them."* (O2O, n.d.). They state on their website that they have helped Carrefour develop online to offline strategies that connect the digital world with the physical one, allowing clients to enjoy benefits and personalized services (O2O, n.d.).

Carrefour has also collaborated with Mastercard as they affirmed in a press release where they ensured that "*Carrefour has relied on the experience and collaboration of Mastercard's services in developing innovation pilots (MC Labs) and providing advice on payments…*" (Carrefour, 2019).

Technologies applied

From a technological perspective, the researcher interprets that the My Carrefour App and the online platform rely on a combination of **artificial intelligence**, **data analytics** and **machine learning** techniques that allow Carrefour to personalise the shopping experience by analysing customer behaviour, purchase history, and browsing patterns. These systems support features such as tailored promotions, product recommendations, and dynamic content updates. Together, these technologies create a unified, data-driven interface that enhances personalisation, strengthens customer engagement, and supports Carrefour's broader omnichannel strategy.

Effects

Based on Chapter 2 and researchers' observation, the My Carrefour App and web interface addresses inefficiencies related to ordering friction by simplifying browsing, search and checkout, lowering the time cost of initiating an online grocery order. Additionally, Carrefour has different delivery methods that can be chosen. By concentrating all the customer access points into one interface, Carrefour addresses the complexity of coordination ensuring a consistent information flow between online ordering and physical operations.

Sourcing and Organising for Innovation

From the researcher's interpretation, Carrefour's online platform and mobile app are classified as **need-pull innovations**. This classification is based on observable factors. First, the initiative is assumed to have originated from customer expectations for convenience, personalisation, and seamless integration between physical and online shopping experiences. According to the company O2O the main goal of Carrefour was "*ensuring a consistent and satisfying customer experience… not only to meet evolving consumer needs, but also to anticipate them"* (O2O, n.d.). Second, it reflects market-driven pressures to enhance digital accessibility and user experience in a competitive retail environment shaped by e-commerce behaviour.

Organisationally, the innovation is interpreted as an **open approach** to innovation. Carrefour developed the app and website in collaboration with O2O, which supported the company's online strategy, and partnered with Mastercard to integrate advanced payment solutions. This openness enables Carrefour to leverage specialised external expertise while improving the digital shopping experience and maintaining strategic coherence across its omnichannel operations.

2) **Home delivery, Carrefour Drive, Click and collect and partnerships**

Describing the innovation

Carrefour has developed a diversified last-mile delivery that offers customers flexibility, speed, and convenience in receiving their online orders. Once a purchase is completed through the My Carrefour App or website, customers can choose among several delivery and collection options designed to adapt to different lifestyles and urban contexts. As shown on the company's website (Figure 8 and Figure 9), Carrefour provides three main last-mile delivery alternatives: Carrefour Drive, Click & Collect, and home delivery (Carrefour, n.d.).

Figure 8: Carrefours last-mile delivery options (Carrefour, n.d.)

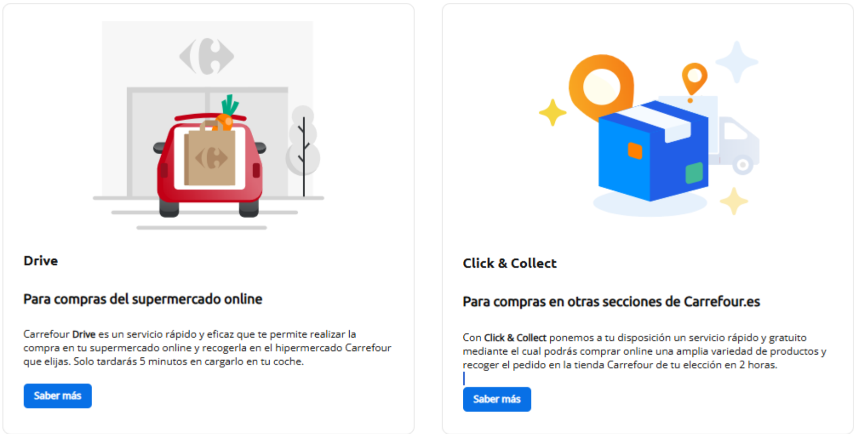

Figure 9: Carrefour Drive and Click and collect alternatives (Carrefour, n.d.)

The first option, **Carrefour Drive**, allows customers to place their grocery orders online and pick them up at the selected hypermarket without leaving their car. As stated by Carrefour, *"Carrefour Drive is a fast and efficient service that lets you shop online and collect your groceries in your chosen store in just five minutes"* (Carrefour, n.d.). According to *Business Insider*, customers simply arrive at the store's Drive point, communicate their order number, and within minutes Carrefour staff load the groceries into the vehicle all without the customer needing to step out (Fernández, 2020). This service requires a minimum purchase of €30 and has become one of Carrefour's key logistics innovations, particularly in suburban and semi-urban areas where convenience and speed are priorities (Carrefour, n.d.).

The **Click & Collect** service is according to Carrefour *"…a fast and free service through which you can buy a wide variety of products online and pick up your order at the Carrefour store of your choice in 2 hours*" (Carrefour, n.d.). If the order is not collected immediately, it remains available for up to seven days before being cancelled (Carrefour, n.d.).

Lastly, Carrefour also offers a **home delivery** service, available in most large cities across Spain. For a minimum purchase of €50, customers can receive their orders directly at home with flexible delivery slots between 10:00 and 22:00 (Carrefour, n.d.). If the order is placed before 16:00, it is delivered within 24 hours; orders made before 22:00 are delivered the following morning (Carrefour, n.d.). According to Carrefour, with this model "*...you will receive your purchase in the best condition and with the maximum guarantee of freshness*" (Carrefour, n.d.).

Additionally, as part of its omnichannel digital transformation, Carrefour has developed a multi-partner delivery ecosystem that extends its last-mile reach through collaborations with external logistics and technology platforms such as Glovo, Uber Eats, and previously Stuart Delivery. These partnerships complement Carrefour's in-house logistics and e-commerce infrastructure, enabling the company to offer rapid delivery services that respond to new customer expectations for immediacy, convenience, and flexibility.

In 2019, Carrefour announced a strategic partnership with **Glovo** to provide a 30-minute grocery delivery service, reinforcing its position as an omnichannel retailer. According to Amélie Oudéa-Castéra, Executive Director of E-commerce, Data and Digital Transformation at Carrefour, *"Carrefour is constantly looking for ways to deliver innovative services that make customers' daily shopping experience easier. With this partnership, Glovo and Carrefour offer a 30-minute delivery service that complements existing e-commerce offers and allows them to address the needs of new customers"* (Carrefour, 2019). As highlighted by *EcommerceNews*, the collaboration aligns with the company's ambition *"to create an omnichannel model and become the leader in online grocery retail"* (Quelle, 2019). Through Glovo's platform, customers can order the groceries that are then collected by the platforms couriers and delivered in the chosen location in 30 minutes (Quelle, 2019). Moreover, as stated in the newsletter *Financial Food*, in 2024, another functionality was added, customers can access Carrefour's virtual store, select products, and receive their orders (Financial Food, 2024).

Similarly, Carrefour expanded its rapid delivery strategy through a partnership with **Uber Eats**, launched in Spain in 2023. According to statements from Alexandre de Palmas, CEO of Carrefour Spain, *"By adding Uber to our list of express delivery partners, we expand the range of options for our customers and consolidate our position as a leader in retail digitalisation and service innovation"* (Financial Food, 2022; Europa Press, 2022; InfoRetail, 2022). Uber Eats' General Manager, Courtney Tims, noted that *"the goal of this agreement is to offer users a more convenient, easy, and fast shopping experience"*, strengthening Uber Eats' position in Spain's grocery delivery segment (Financial Food, 2022; Europa Press, 2022; InfoRetail, 2022).

Carrefour also collaborated with **Stuart Delivery**, integrating its API directly into Carrefour's e-commerce portal. According to *Alimarket*, this system enabled stores of different formats to offer flexible deliveries, either immediate or scheduled within 30-minute time windows, handled by independent local couriers (Alimarket, 2016). However, as reported by *ConfiLegal*, Stuart withdrew from the Spanish market due to growing competition from larger platforms such as Glovo and Uber Eats (ConfiLegal, 2025).

Technologies applied

From a technological perspective, these last-mile delivery solutions can be assumed to rely on a combination of digital tools that support order preparation, routing and coordination. Carrefour's Drive, Click & Collect and home delivery systems likely use **AI-driven** and **data-analytics** tools that help synchronise inventory availability with customer orders. The partnerships with delivery platforms appear to depend on **API** integrations that connect Carrefour's e-commerce system with external couriers and probably enable real time tracking. Additionally, **AI-based routing and optimisation algorithms** may support the home-delivery service by reducing travel time and improving delivery accuracy. Together, these technologies form a digitally enabled last mile infrastructure that supports Carrefour's omnichannel and rapid delivery ambitions.

Effects

These innovations address multiple inefficiencies and complexities inherent in last-mile grocery delivery seen in Chapter 2. First, the Drive and Click & Collect models address inefficiencies such as delivery time and transportation costs, since customers assume part of the last-mile journey. Meanwhile, home delivery enhances delivery reliability. By collaborating with specialised delivery platforms, Carrefour addresses delivery times inefficiencies, logistics costs, and fleet management complexity, transferring much of the operational responsibility to expert partners.

Moreover, by offering multiple fulfilment options, Carrefour addresses one of the most complex challenges in grocery logistics, service flexibility. Drive and Click & Collect services reduce the complexity associated with low stop-density home deliveries by eliminating many failed delivery attempts and routing uncertainty. The partnerships enable Carrefour to handle highly variable urban demand and geographically dispersed delivery zones, they shift multi-actor coordination and rider scheduling to the platform, without overextending its internal resources.

Sourcing and Organising for Innovation

Based on the analysis of the available data, the researcher classifies these innovations as a **combination of need-pull and technology-push**. This classification is grounded in two main observations. First, as it was stated in the description of the innovation, Carrefour emphasises in its public statements that its goal is to offer customers the most convenient way to receive their groceries, allowing them to choose the delivery method that best fits their lifestyle. This customer-centric orientation reflects a clear need-pull logic, as the company develops multiple delivery modes to provide flexibility, speed, and minimal effort for the consumer.

At the same time, platform-based logistics solutions also reveal a **technology-push** component, enabled by advances in delivery management and API-based coordination technologies. Organisationally, this innovation is interpreted as a **mixed open and closed**

approach. Carrefour collaborates with external partners such as Uber Eats, Glovo, and Stuart, which enhances scalability and allows the company to respond quickly to fluctuations in demand while limiting investment in proprietary infrastructure. However, for Carrefour Drive, Click & Collect, and home delivery, the company relies on its own internal resources, demonstrating a parallel commitment to maintaining operational control within its last-mile network.

3) Micro-Fulfilment Centres

Describing the innovation

To support its growing volume of online orders, Carrefour has, like Mercadona, integrated micro-fulfilment centres in Spain. Similar to Mercadona's Colmenas, these facilities are designed to manage e-commerce demand without congesting physical stores. Although Carrefour's investment in dedicated fulfilment infrastructure has been more limited, the company has adopted a hybrid approach that combines store-based preparation areas with centralised logistics hubs.

In 2022, Carrefour announced the opening of a new e-commerce logistics platform in Getafe (Madrid), operated by Salvesen Logística, marking a major step in the digitalisation of its Spanish supply chain. As stated by Alexandre Bompard, CEO of Carrefour Group: *"The opening of the Getafe platform illustrates the great progress of our digital roadmap in Spain. E-commerce is attracting more and more customers and is now one of the most important growth factors, alongside the digitalisation of our financial services and retail media. In Spain, as across the Group, we will continue to accelerate our investments to innovate for our customers, create new jobs, and transform Carrefour into a Digital Retail Company."* (Carrefour, 2022)

In this press note, Carrefour revealed that this warehouse thanks to Salvasen, incorporates advanced operational technologies like order planning systems, dynamic routing management, and AI-driven packaging algorithms that optimise space utilisation in delivery vehicles (Carrefour, 2022). Additionally, they affirmed that it features dedicated preparation zones for fresh products, such as meat, fish, and bakery, which are assembled just minutes before dispatch, ensuring optimal freshness and quality (Carrefour, 2022).

Technology applied

Carrefour's technology in this micro-fulfilment centres appear to include a combination of **automation, robotics, AI, and IoT**. AI-powered algorithms can be used to plan order batches, optimise packaging configurations, and dynamically assign routes based on real-time demand data. Meanwhile, IoT and data analytics can support continuous monitoring of inventory levels, and temperature, ensuring reliability and product integrity throughout the process. The integration of automated workflows and real-time monitoring improves coordination between picking, packing, and delivery stages, thereby addressing inefficiencies and delays in last-mile operations.

Effects

The implementation of micro-fulfilment tackles inefficiencies in last-mile logistics. First, it addresses store congestion and operational bottlenecks, as online orders are processed separately from in-store activities. Second, it addresses inefficiencies in picking speed and accuracy through automation. These micro-fulfilment centres also address complexities such as synchronising high-frequency online orders with physical store flows and complexities related with temperature sensitive logistics, a central complexity identified in omnichannel grocery literature.

Sourcing and Organising for Innovation

From the researcher's perspective, this innovation is categorised as a **technology-push** initiative developed through an **open innovation** approach. The classification as technology-push is based on the fact that its origin is assumed to lie in technological advancements in automation, robotics, and AI-enabled logistics management rather than direct market demand. Carrefour appear to have adopted these technologies to address inefficiencies and complexities in the last-mile delivery, such as congestion in store-based picking, limited scalability of online fulfilment, and the need for faster order preparation, rather than in response to explicit customer requests.

At the same time, Carrefour's collaboration with Salvesen Logística illustrates an **open innovation** practice, in which external partners contribute specialised expertise in logistics operations and warehouse automation. This partnership allows Carrefour to integrate advanced technological solutions developed externally while aligning them with its own operational objectives and digital transformation strategy.

4) **Predictive last-mile scheduling**

Describing the innovation

Carrefour has also implemented predictive AI-based systems to enhance planning and coordination in last-mile delivery. As reported by *Logispyme*, the company *"…has implemented an artificial intelligence system for demand forecasting and inventory planning"* (López, 2025). According to the newsletter, these systems analyse historical sales data alongside external variables such as weather patterns, local consumption behaviour, special events, or social trends (López, 2025). This enables more precise estimation of demand fluctuations and supports Carrefour in preventing stock-outs of high-turnover fresh products, thereby improving service levels and customer satisfaction (López, 2025).

In an interview with *Autels Insights*, Carrefour's CIO highlighted the importance of AI in the company's transformation roadmap, noting initiatives such as the *"…Data & AI Academy, cloud acceleration, and the implementation of concrete use cases such as new online product recommenders, our Intelligent Contact Centers, computer vision for* *quality control of fresh produce in stores and warehouses, and real-time analysis of customer opinion…"* (Sanchez, 2025*)*. These developments reflect the scope and maturity of Carrefour's AI integration across multiple operational layers.

According to *Cadena de Suministro*, "*Carrefour has started using the SAS Viya artificial intelligence solution to optimize its supply chain and improve its inventory management from an omnichannel perspective"* (De Aspuru, 2019). The system consolidates data from physical stores, warehouses, and e-commerce channels, allowing the replenishment teams to align forecasting, stock policies and replenishment cycles (De Aspuru, 2019). The platform also enables Carrefour to develop customised algorithms for demand forecasting and stock optimisation (De Aspuru, 2019). Additionally, according to *Artefact*, Carrefour has partnered with Google & Artefact to accelerate the use of AI in assortment planning, pricing, supply chain optimisation, in-store operations and online commerce (Artefact, 2024).

Technologies applied

From a technological perspective, Carrefour's predictive last-mile scheduling appears to rely primarily on **artificial intelligence** and **data analytics** systems capable of processing large volumes of operational and environmental data, combined with **machine-learning** algorithms that refine forecasts over time. These systems are supported by advanced analytics platforms, such as SAS Viya, and cloud-based infrastructures developed in collaboration with Google and Artefact, which enable the consolidation of data across channels and locations. Through this technological foundation, Carrefour enhances demand planning and improves stock rotation.

Effects

Predictive demand and inventory management address several inefficiencies from Chapter 2. By improving forecast accuracy, Carrefour addresses overproduction and stockouts which are costly inefficiencies. In parallel, predictive models contribute to addressing key complexities. Forecasting systems address the complexity of synchronising demand signals across multiple preparation nodes (physical stores, MFC nodes, 3rd-party delivery nodes). Fresh categories have high perishability, volatile demand, and strong sensitivity to weather and local context. By integrating multiple data layers, the system can coordinate decisions across multiple fulfilment activities. This supports the orchestration of inventory flows in a multichannel context, contributing to synchronisation between online and offline stock.

Sourcing and Organising for Innovation

From the researcher's standpoint, this innovation is classified as a **hybrid initiative**, combining both **technology-push** and **provider-driven need-pull** dynamics. The interpretation of technology-push is based on the adoption of advanced AI, machine learning, and data-analytics capabilities that enabled Carrefour to automate forecasting and optimise inventory management. These developments emerge from technological opportunities, particularly the growing maturity of cloud-based predictive platforms and real-time data analytics, rather than from direct consumer demand.

At the same time, a provider-driven need-pull dynamic is also interpreted. Suppliers and technology partners increasingly required better data integration and real-time visibility across the supply chain to coordinate replenishment and production more efficiently. These external expectations create an additional source of innovation demand, prompting Carrefour to implement forecasting systems.

Organisationally, this innovation is interpreted as an **open approach**, as Carrefour collaborates with external technology actors such as SAS, Google, and Artefact. These partnerships enhance Carrefour's capabilities, accelerate implementation, and reduce the costs and risks of developing such complex systems internally. The integration of external expertise within Carrefour's data ecosystem therefore reflects a strategically open yet coordinated model of innovation.

5.2.2. Approaches for Innovation

This subsection examines how Carrefour approaches innovation in relation to the technological innovations identified in the previous chapter. The aim is to analyse how they are sourced and governed. First, a table (Figure 10) will classify each innovation according to whether, from the researcher's assumptions, it appears to emerge mainly from technology-push or need-pull mechanisms, and whether its organisational form aligns more with a closed or an open innovation orientation. Second, another table (Figure 11) will summarise which inefficiencies and complexities of last-mile delivery each innovation addresses.

Innovation	Technology	Source	Approach	Collaborations
My Carrefour App and web	AI and data analytics	Need-pull	Open	Technology provider and Bank
Carrefour Drive and Click and collect	AI, automation and data analytics	Need-pull	Closed	-
Home Delivery	AI and data analytics	Need-pull	Closed	-
Delivery with other platforms	AI, data analytics, API integrations	Technology-push+Need-pull	Open	Delivery platforms (Apps)
Micro-Fulfiment centres	Automation, IoT, AI and robotics	Technology-push	Open	Logistic company

Predictive last-mile scheduling	AI, data analytics and machine learning	Technology-push+Need-pull	Open	Technology provider

Figure 10: Summary of Carrefour's Innovations

The table in Figure 10, highlights how the company combines both technology-push and need-pull dynamics, as well as open and closed innovation practices, to address inefficiencies and complexities in last mile delivery.

Regarding the **sources of innovation**, Carrefour's transformation is interpreted to be driven by both **technology-push** and **need-pull** innovations. Need-pull driven by customers demand is especially evident in the My Carrefour App, web platform, Click and collect, Carrefour Drive and home delivery services, which were developed to meet growing expectations for convenience, personalisation, and speed. Additionally, the need-pull driven by suppliers is evident in predictive demand algorithms and inventory management. In contrast, **technology-push** forces play a greater role in innovations such as micro-fulfilment centres and predictive last-mile scheduling, which stem from advancements in automation, AI, and analytics rather than explicit consumer requests.

Some innovations, such as Drive and Click & Collect and Predictive Scheduling, combine both dynamics and can be understood as **coupling innovations,** in line with Rothwell's model (1994). These initiatives arise from technological opportunities while also responding to external needs from customers and suppliers in last-mile delivery. In line with Maier, Ho, and Branzei (2016), this interaction can also be observed at the organisational level, where Carrefour applies different innovation logics across its portfolio, some purely need-pull, others technology-push, and several combining both. This pattern supports the interpretation that Carrefour's last-mile transformation represents a strategically **coupling model** innovation system.

In the context of this thesis, the analysis focuses on the Spanish market, which by the researcher of the thesis is understood as one of the **decentralised** operational units of the Carrefour Group. However, since companies do not disclose all of their organisational structures or specific activities, this assumption is based on interpretation rather than verified data.

Furthermore, Carrefour is interpreted to have a **predominantly open approach** to innovation. Rather than internalising the entire development process, Carrefour strategically collaborates with external partners, technology providers, and digital platforms to integrate new capabilities into its logistics network. Consequently, the company's innovation capacity is not confined to internal resources but distributed across technology providers and partners, including Google Cloud, Artefact, SAS Viya, Glovo, and Uber Eats, that contribute complementary technologies, data infrastructures, and analytics expertise. Nevertheless, Carrefour also maintains a closed model of innovation for certain initiatives, such as Drive, Click & Collect, and home delivery, where operational control and internal coordination are prioritised.

Innovation	Inefficiencies addressed	Complexities addressed
My Carrefour App and Web	Ordering friction and time cost	Simplifies multi-modal fulfilment access by centralising the customer interface
Carrefour Drive and Click and Collect	Delivery costs	Failed deliveries, delivery routes and low stop density
Home delivery	Route inefficiencies	-
Partnership with delivery platforms	Transportation costs and logistics and delivery time	Multi-actor coordination
Micro-Fulfilment centres	In-store congestion and picking and packing	Coordination between online and offline logistics
Predictive demand and inventory management	Stockouts, overstock and fresh produce waste	Multi-node demand synchronisation complexity

Figure 11: Carrefour's Innovations and the inefficiencies and complexities it addresses

Figure 11 summarises, based on observation and the literature in Chapter 2, the main inefficiencies and complexities addressed by Carrefour's technological innovations in last-mile logistics. The table illustrates how each initiative addresses specific inefficiencies and complexities across the supply chain. Customer-facing innovations such as the My Carrefour App and Web focus on reducing ordering friction and simplifying access to multiple fulfilment options. Operational initiatives, including Drive, Click & Collect, and home delivery, aim to minimise delivery costs, route inefficiencies, and failed deliveries. Meanwhile, partnerships with external delivery platforms address the need to optimise logistics time and coordination among multiple actors. At a structural level, micro-fulfilment centres and predictive demand and inventory management systems target deeper inefficiencies and complexities, such as congestion in store-based picking, stock imbalances, and multi-node demand synchronisation.

In conclusion, Carrefour's innovation approach in the Spanish market reflects an effort to systematically address the inefficiencies and complexities inherent in last-mile delivery. Each technological initiative contributes to improving these across the distribution network. The company has a predominantly open approach, working collaboratively with external partners but maintaining control over core operations. From the researcher's standpoint, Carrefour's digital transformation follows a coupling model at the organisational level, where technology-push and need-pull forces interact dynamically to enhance both technological capability and service quality within its last-mile logistics system.

5.3. Comparative Analysis

This section provides a comparative analysis of the technological innovations implemented by Mercadona and Carrefour, examining how each company leverages digital tools to address inefficiencies and complexities in last-mile delivery. While both retailers operate in the same market and deploy similar types of innovations, online platforms, fulfilment systems, delivery models, and forecasting, the strategic logic guiding their development and the organisational structures supporting them differ substantially. By comparing the two cases, the analysis highlights convergences and divergences in sourcing logic and organisational approaches. This comparison allows for a deeper understanding of how distinct organisational strategies shape the digital transformation of last-mile logistics, providing insights that extend beyond the individual cases.

Company	Innovation	Source	Approach	Inefficiency	Complexity
Mercadona	Mercadona Online and App	Need-pull	Closed+Open	Ordering friction and time cost	-
	Delivery fleet	Need-pull+Technology-push	Closed+Open	Transportation costs and inefficient routing	Maintaining temperature-sensitive logistics
	Colmenas	Technology-push	Closed	In-store congestion, low pick rate and labour waste	Coordination between online and offline logistics and managing multiple temperatures
	Predictive demand and Inventory management	Need-pull+Technology-push	Closed	Overproduction and stockout and inefficient replenishment cycles	Perishability-driven demand uncertainty and replenishment interdependence
Carrefour	My Carrefour App and Web	Need-pull	Open	Ordering friction and time cost	Simplifies multi-modal fulfilment access by centralising the customer interface
	Drive and Click and Collect	Need-pull	Closed	Delivery costs	Failed deliveries, delivery routes and low stop density
	Home Delivery	Need-pull	Closed	Route inefficiencies	-
	Delivery platforms	Technology-push+Need-pull	Open	Transportation costs and logistics and delivery time	Multi-actor coordination
	Micro-Fulfilment centres	Technology-push	Open	In-store congestion and picking and packing	Coordination between online and offline logistics
	Predictive demand and Inventory Management	Technology-push+Need-pull	Open	Stockouts, overstock and fresh produce waste	Multi-node demand synchronisation complexity

Figure 12: Summary of Mercadona's and Carrefour's innovation

Based on the observation of both case studies, Mercadona and Carrefour address similar categories of inefficiencies and complexities within their last-mile logistics operations, but they do so through distinct strategic and technological approaches. While both companies aim to enhance speed, reliability, and efficiency in last-mile delivery, Mercadona's approach is interpreted as a more closed system, whereas Carrefour's model is interpreted as a more collaborative system. This difference reflects two distinct strategic logics for addressing last-mile inefficiencies: one centred on integration, and the other on distributed collaboration.

The analysis of both cases reveals that Mercadona and Carrefour adopt distinct yet complementary strategies in sourcing and organising for innovation, reflecting their different operational logics and organisational structures.

Mercadona's innovation model is interpreted as a coupling model with a mostly closed approach, where most technological developments are conceived, designed, and implemented internally by their R&D departments. The company's innovation process is driven by both technology-push and need-pull forces but tightly controlled. Technology-push initiatives, such as Colmenas, delivery fleet and predictive demand systems, appear to have emerged from internal capabilities and the adoption of automation and AI technologies to optimise operations. Need-pull dynamics are observed in innovations like Mercadona Online and the mobile app, which appear to respond to customer expectations for convenience and service quality, and predictive demand and inventory management that address provider's needs. However, even in these cases, external collaboration is minimal, limited to specific technological providers or software tools or customers opinion. This is interpreted as a preference for Mercadona, that maintains strategic autonomy and full integration across its logistics network, as long as it is publicly displayed, ensuring that innovation outcomes align with the inefficiencies and complexities that need to be addressed.

In contrast, Carrefour's innovation model is interpreted as a coupling model with a mostly open approach. The company's digital transformation appears to combine technology-push innovations, such as micro-fulfilment centres, the delivery with other platforms, and predictive demand and inventory management systems, with need-pull initiatives like My Carrefour App, Drive, Click & Collect, and home delivery, and predictive demand and inventory management. These latter projects appear to be influenced by evolving customer expectations for speed, flexibility, and convenience, and by the provider's needs. Carrefour's openness to external collaboration is evident in its partnerships with Google Cloud, SAS, Artefact, and delivery platforms such as Glovo, Uber Eats, and Stuart, which provide complementary digital infrastructures and logistics capabilities. This distributed approach enables Carrefour to remain agile, scalable, and responsive to market and supplier needs while limiting internal investment risks.

Comparatively, Mercadona's approach can be seen as internally driven and vertically integrated, while Carrefour's approach is externally connected and collaboration oriented. Both companies, however, demonstrate forms of coupling innovation, as proposed by Rothwell (1994), where technology-push and need-pull forces interact dynamically within individual innovations. In line with Maier, Ho, and Branzei (2016), these dynamics also appear at the organisational level: Mercadona applies coupling through internal technological convergence, whereas Carrefour achieves it through network-based collaboration. Together, these models illustrate two distinct pathways to achieving innovation in last-mile logistics, one through internal consolidation of resources, and the other through strategic openness and external partnerships.

From the researcher's perspective, these findings highlight that there is no single optimal model for digital transformation in last-mile logistics. Instead, the effectiveness of innovation depends on the firm's capabilities, strategic objectives, and configuration. The coupling model of technology-push and need-pull forces, whether internal or external, is proposed here to be a determinant of innovation performance in the landscape of retail logistics.

6. Discussion

This chapter aims to answer the general research question by proposing an answer for the two sub research questions:

"What technological innovations within last-mile delivery have Mercadona and Carrefour implemented to address the inefficiencies and complexities?"

"How do the organising and sourcing approaches to innovation influence the way these technological innovations address inefficiencies and complexities in last-mile delivery?"

The two case analyses show that both companies have developed technological innovations aimed at addressing inefficiencies and complexities in last-mile delivery. Both firms introduce innovations across different stages of the last-mile chain, with solutions that are largely similar in nature, but differentiated in their innovation approach and organisational structure.

Both companies have introduced online platforms and mobile apps that streamline the shopping process, addressing inefficiencies such as ordering friction and time costs, while addressing complexities related to accessibility and the coordination of multiple fulfilment channels. To fulfil online orders effectively, both companies have invested in fulfilment infrastructure and delivery systems. Mercadona developed its Colmenas (urban fulfilment centres) and in-house delivery fleet, which address inefficiencies in in-store picking, route optimisation, and delivery quality. These initiatives also respond to complexities such as multi-temperature control and cold-chain management. Carrefour, on the other hand, has implemented a diversified delivery ecosystem, combining Drive, Click & Collect, home delivery, and collaborations with external platforms such as Glovo and Uber Eats. This model addresses inefficiencies in route density and delivery costs while managing the coordination complexities of a multi-actor logistics network. Both companies have also developed predictive demand and inventory management systems, integrating AI-based forecasting and data-analytics tools. These systems address inefficiencies such as stockouts, overstock, and food waste, and complexities related to synchronising variable demand and inventory flows across multiple nodes.

Together, these results show that in both cases the introduction of digital tools, apps, routing optimisation, fulfilment automation, and predictive data models, directly addresses the inefficiencies and complexities that characterise last-mile delivery in grocery retail. However, the mechanisms through which these technologies are organised differ substantially.

Mercadona is interpreted to follow a predominantly closed model of innovation, relying on its internal divisions, to design, develop, and implement technological solutions. Its sourcing of innovation appears to combine technology-push and need-pull elements within a coupling logic. Technology-push is evident in initiatives such as Colmenas, delivery fleet and predictive demand systems, which arose from internal capabilities and technological opportunities in automation and data analytics. Need-pull forces emerge from customer expectations for convenience and reliability, as seen in the online platform and app and from suppliers' needs in the predictive demand and inventory management algorithms. Nevertheless, even in these cases, collaboration remains limited to selective technology providers or customers opinions. Mercadona's approach therefore reflects an internally integrated coupling model, where innovation results from the convergence of internal technological and market-driven dynamics under tight organisational control.

Carrefour, by contrast, is interpreted as a mostly open organisational model, alternating between internal control and external collaboration depending on project scope. Its sourcing logic also appears to combine technology-push and need-pull forces. Technology-push is visible in the deployment of micro-fulfilment centres and predictive scheduling systems, enabled by advances in automation, AI, and data-analytics platforms. Meanwhile, need-pull forces arise from both customer expectations, driving innovations such as the My Carrefour App, Drive, and home delivery, and supplier requirements for data integration and coordination. The company collaborates extensively with technology providers (Google Cloud, SAS, Artefact) and logistics platforms (Glovo, Uber Eats, Stuart), distributing innovation capabilities across external partners.

When analysing how these organisational and sourcing approaches influence innovation performance, it is interpreted by the researcher that the level of openness determines how effectively each company can address inefficiencies and complexities. Mercadona's closed model can enable deep technical integration and consistency in execution, ideal for controlling variables such as temperature management, delivery reliability, and fulfilment efficiency. Carrefour's open network, by contrast, can enhance adaptability and scalability, allowing it to respond quickly to fluctuating demand, but it can require more coordination to maintain quality and reliability across partners.

Theoretically, these configurations reflect two applications of the coupling model proposed by Rothwell (1994), where innovation arises from the interaction between technological capability and market need. Mercadona represents an internally integrated coupling model, where push and pull forces converge within a single organisational system. Carrefour, conversely, embodies an externally networked coupling model, where innovation results from inter-organisational collaboration and the alignment of multiple partners. In line with Maier, Ho and Branzei (2016), this analysis suggests that coupling can occur both at the innovation level and at the organisational level, and that its effectiveness depends on how technological and market forces are coordinated within or across organisational boundaries.

From the researcher's standpoint, these findings imply that the effectiveness of technological innovation in addressing inefficiencies and complexities depends not only on the technologies themselves but on how innovation is structured and governed. Closed systems, such as Mercadona's, can generate coherence, and operational control, while open systems, like Carrefour's, can enable responsiveness, experimentation, and faster adoption. The most effective approach proposed by the researcher for large grocery retailers may therefore lie in a hybrid configuration, combining internal digital capabilities for core operations with external collaborations for specialised technologies with a coupling model at the organisational and innovation level.

Ultimately, this study proposes digital transformation in last-mile logistics to be conceived not as a collection of isolated tools, but as a systemic process that couples technology with market responsiveness. The interplay between sourcing and organisation determines whether technological innovation can truly address inefficiencies and complexities.

7. Conclusion

This thesis aims to answer the following research question: "*How can large grocery retailers implement digital transformation strategies, through technological innovations, that address the inefficiencies and complexities in last-mile delivery?*"

The comparative evidence from Mercadona and Carrefour is interpreted by the researcher in a way that there is not a single optimal configuration of digital transformation. Instead, the ability to address last-mile inefficiencies and complexities depends on how digital technologies are embedded into the operating logic of the firm. Both retailers have implemented similar technological levers, apps and web channels, optimised delivery fleets, micro-fulfilment capabilities, and predictive algorithms yet the organisational pathways through which these technologies are implemented differ.

Critically, the researcher's interpretation from the comparative analysis is that the most effective path is not purely internal or purely collaborative. The most effective path is a hybrid approach, internal development for core operations combined with external partnerships for specialised technological capabilities. This balance enables integration and system coherence, typically achieved by closed, centralised development, while retaining the speed and experimentation capacity that external technological collaborations can provide.

Furthermore, the researcher concludes from the case comparison that digital transformation in grocery retail logistics is neither exclusively technology-push nor exclusively need-pull**.** Both cases illustrate a coupling dynamic where digital transformation emerges from the interaction between market needs and technological opportunities at the organisational level**.** Digital transformation is therefore obtained not because it reacts to market alone, nor because it deploys advanced technology in isolation, but because it strategically aligns both.

From a theoretical standpoint, this thesis contributes to the literature by demonstrating how sources of innovation (push/pull) and organising for innovation (open/closed) interact in practice when applied to operational logistics. From a managerial perspective, the implication lies on that scaling last-mile performance requires designing digital transformation as a system, not as a collection of isolated technological projects. Retailers seeking to replicate the success of Mercadona or Carrefour should prioritise organisational architectures that enable dynamic coupling between technological R&D and operational signals from the market.

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Appendix A

	Title	Link	Author
Chapter 2	Innovative solutions to increase last-mile delivery efficiency in B2C e-commerce: a literature review	https://doi.org/10.1108/IJPDLM-02-2019-0048	Mangiaracina et al. (2019)
Chapter 2	Autonomous Delivery Solutions for Last-Mile Logistics Operations: A Literature Review and Research Agenda	https://doi.org/10.3390/su15032774	Engesser et al. (2023)
Chapter 2	The Impact of E-Commerce-Related Last-Mile Logistics on Cities: A Systematic Literature Review	http://dx.doi.org/10.3390/su12166492	Viu-Roig y Alvarez-Palau (2020)
Chapter 2	Investigating Returns Management across E-Commerce Sectors and Countries: Trends, Perspectives, and Future Research	https://doi.org/10.3390/logistics8030082	Stevenson y Rieck (2024)
Chapter 2	Forecasting e-commerce consumer returns: a systematic literature review	https://doi.org/10.1007/s11301-024-00436-x	Karl (2024)
Chapter 2	Last mile logistics: Research trends and needs	https://doi.org/10.1093/imaman/dpac006	Demir et al. (2022)
Chapter 2	Digital transformation in e-commerce logistics: a case study on the digital maturity of the last-mile area	https://doi.org/10.14488/BJOPM.1641.2024	Tabim et al. (2024)

Chapter 2	The impact of digital transformation on supply chains through e-commerce: Literature review and a conceptual framework	https://doi.org/10.1016/j.tre.2022.102837	Mashalah et al. (2022)
Chapter 2	Last-mile delivery concepts: a survey from an operational research perspective	https://doi.org/10.1007/s00291-020-00607-8%0A	Boysen et al. (2020)
Chapter 2	Autonomous last-mile delivery robots: a literature review	https://doi.org/10.1186/s12544-023-00629-7	Alverhed et al. (2024)
Chapter 2	Intelligent Warehouse in Industry 4.0—Systematic Literature Review	https://doi.org/10.3390/s23084105	Tubis y Rohman (2023)
Chapter 2	Strategic insights into last-mile delivery: modelling the industry 4.0 enabler for e-commerce industry	https://doi.org/10.1108/RAUSP-07-2024-0146	Sharma et al. (2025)
Chapter 2	Enhancing Sustainable Last-Mile Delivery: The Impact of Electric Vehicles and AI Optimization on Urban Logistics	https://doi.org/10.3390/wevj16050242	Ferreira y Esperança (2025)
Chapter 2	The Role of Micro Fulfilment Centers in Alleviating, in a Sustainable Way, the Urban Last Mile Logistics Problem: A Systematic Literature Review	https://doi.org/10.3390/su16208774	Karaoulanis (2024)
Chapter 2	Enhancing Last-Mile Logistics: AI-Driven Fleet Optimization, Mixed Reality, and Large	https://doi.org/10.3390/s25092696	Ieva et al. (2025)

	Language Model Assistants for Warehouse Operations		
Chapter 2	Parcel locker solutions for last-mile delivery: a systematic review.	https://doi.org/10.3389/ffutr.2025.1654621	Zhang y Demir (2025)
Chapter 2	AI in Logistics – Frameworks for Intelligent Routing and Operational Optimization in Supply Chains	http://dx.doi.org/10.63345/ijrmeet.org.v13.i6.1	Tathed (2025)
Chapter 2	Industry 4.0 Technologies and Sustainable Warehousing: A Systematic Literature Review	https://ieomsociety.org/proceedings/2021indonesia/26.pdf	
Chapter 2	Toward a Modern Last-Mile Delivery: Consequences and Obstacles of Intelligent Technology	https://doi.org/10.3390/asi5040082	Sorooshian et al. (2022)
Chapter 2	Innovations, Technologies, and the Economics of Last-Mile Operations: A Call for Research in Operations Management	https://doi.org/10.1002/joom.1355	Agatz et al. (2025)
Chapter 2	Understanding the role of information and digital technologies of industry 4.0 on last-mile logistics: current state and prospective research avenues	https://dialnet.unirioja.es/servlet/articulo?codigo=9948498	Deschutter et al. (2025)
Chapter 2	Characterization and Design for Last Mile Logistics: A Review of the State of the Art and Future Directions	https://doi.org/10.3390/app12010118	Na et al. (2021)

Chapter 2	Last mile fulfilment and distribution in omni-channel grocery retailing: a strategic planning framework	https://doi.org/10.1108/ijrdm-11-2014-0154	Hübner et al. (2016)
Chapter 2	Improving supply chain planning for perishable food: data-driven implications for waste prevention	https://doi.org/10.1007/s11573-024-01191-x	Birkmaier et al. (2024)
Chapter 2	A cost-based comparative analysis of different last-mile strategies for e-commerce delivery	https://doi.org/10.1016/j.tre.2022.102783	Pahwa & Jaller (2022)
Chapter 3	Managing innovation integrating technological, market and organizational change	https://mrce.in/ebooks/Managing%20Innovation%207th%20Ed.pdf	Tidd, Joe, et al (2018)
Chapter 3	Demand-pull, technology-push, and the direction of technological change	https://doi.org/10.48550/arxiv.2104.04813	Hötte (2021)
Chapter 3	Technology push and demand pull perspectives in innovation studies: Current findings and future research directions	https://doi.org/10.1016/j.respol.2012.03.021.	Di Stefano et al. (2012)
Chapter 3	The Logic of Open Innovation: Managing Intellectual Property	https://doi.org/10.1177/000812560304500301	Chesbrough (2003)

Appendix B

Company	Innovation	Technology	Link
Mercadona	App and shopping online	Machine learning, AI and data analytics	https://www.economiadigital.es/empresas/llega-la-app-de-mercadona-para-compras-de-mas-de-50-euros_557648_102.html
			https://info.mercadona.es/document/es/memoria-anual-2018.pdf
			https://www.elespanol.com/omicrono/20200420/funciona-app-mercadona-hacer-compra-online/483951850_0.html
Mercadona	Colmenas	Automation, AI, robotics, and IoT	https://valenciaplaza.com/valenciaplaza/mercadona-online-colmenas-nuevo-modelo
			https://www.eleconomista.es/especial-ecommerce/noticias/10794506/09/20/Mercadona-la-reina-de-la-distribucion-teje-su-red-de-colmenas.html
			https://info.mercadona.es/document/es/memoria-anual-2021.pdf
Mercadona	In-house delivery fleet and route optimisation	AI, optimisation algorithms, data analytics, machine learning and IoT	https://wisetrace.com/caso-de-exito/mercadona/#:~:text=Cadena%20de%20fr%C3%ADo%20bajo%20control,de%20inmediato%20ante%20cualquier%20incidencia.
			https://europe.thermoking.com/mediaroom/thermo-king-teams-up-with-mercadona-in-spain-to-make-zero-emission-all-electric-home-deliveries
			https://simpliroute.com/es/blog/logistica-de-mercadona
			https://info.mercadona.es/es/cuidemos-el-planeta/nuestros-hechos/la-apuesta-por-el-transporte-sostenible-en-mercadona/news

Mercadona	Predictive demand and inventory management	AI, machine learning and data analytics	https://logispyme.com/2025/03/25/ia-en-retail-mejora-en-la-prevision-de-demandas-de-supermercados/
Carrefour	App	AI, automation and data analytics	https://www.carrefour.es/clubcarrefour/app-mi-carrefour/
			https://www.revistainforetail.com/noticiadet/la-app-de-carrefour-alcanza-el-millon-de-usuarios/62feaff7966462f9c4216417bddc8f15
			https://www.elespanol.com/elandroidelibre/aplicaciones/20230611/probamos-carrefour-activar-descuentos-codigos-barras-aplicar/769173159_0.html
Carrefour	Micro-fulfilment centres	Automation, IoT, AI and robotics	https://www.carrefour.es/grupo-carrefour/sala-de-prensa/noticias.aspx?tcm=tcm:5-55067
Carrefour	Delivery	AI, data analytics, API integrations	https://www.carrefour.es/servicios/drive-y-click-and-collect.e
			https://www.carrefour.es/servicios/click-and-collect.e
			https://www.drop-point.com/clientes/carrefour/
			https://www.carrefour.es/supermercado/servicios/envios-24-horas.e
			https://www.20minutos.es/noticia/840267/0/
			https://financialfood.es/carrefour-impulsa-el-quick-commerce-de-la-mano-de-glovo/
			https://www.carrefour.com/en/news/carrefour-and-glovo-sign-strategic-partnership-four-countries-order-offer-30-minute-grocery
			https://ecommerce-news.es/carrefour-y-glovo-se-unen-en-cuatro-paises-para-ofrecer-pedidos-de-supermercado-a-domicilio-en-30/
			https://financialfood.es/carrefour-se-alia-con-uber-eats-y-refuerza-su-servicio-de-compra-online/

			https://www.revistainforetail.com/noticiadet/carrefour-impulsa-las-entregas-rapidas/32b99afc52909d08d0c823c7474408dc
			https://www.europapress.es/economia/noticia-carrefour-uber-eats-asocian-llevar-compra-domicilio-20220623100150.html
			https://confilegal.com/20250215-stuart-abandona-el-negocio-de-reparto-en-espana-por-falta-de-competitividad-frente-a-otras-plataformas-no-adaptadas-a-la-ley-rider/
			https://www.alimarket.es/logistica/noticia/227289/la-empresa-de-entrega-inmediata-stuart-llega-a-madrid
Carrefour	AI for predictive last-mile scheduling	AI, data analytics and machine learning	https://logispyme.com/2025/03/25/ia-en-retail-mejora-en-la-prevision-de-demandas-de-supermercados/
			https://autelsinsights.es/el-retail-en-2030-un-futuro-impulsado-por-la-ia-generativa/
			https://www.cadenadesuministro.es/noticias/carrefour-optimizara-su-cadena-de-suministro-con-herramientas-de-inteligencia-artificial_1296252_102.html
			https://www.artefact.com/es/cases/carrefour-google-data-lab-using-ai-to-drive-value-in-store/