# The Future of Grocery Shopping? A Taxonomy-Based Approach to Classify E-Grocery Fulfillment Concepts

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**Abstract.** In order to cope with competition and sustain business performance within a digital environment, grocery providers need to identify and establish suitable fulfillment models. During the last two decades, a huge amount of fulfillment concepts has emerged, emphasizing different focus points. With this contribution, we aim to structure the field of e-grocery fulfillment and support retailers in choosing or refining profitable fulfillment models. Based on a systematic literature review and several fulfillment instances, we developed a taxonomy with 20 dimensions and 61 characteristics. Subsequently, a cluster analysis was employed to identify six concept archetypes, serving as useful basis for digital grocery business. Ultimately, our results provide a foundation for both academia and retail to advance the knowledge of e-service fulfillment models.

**Keywords:** Digital Transformation, Taxonomy, Home Delivery, E-Grocery, Cluster Analysis

## 1 Introduction

Innovative business models are at the core of a company's success. Consequently, organizations across all industries have recently conducted a variety of initiatives to explore, implement and utilize digital technologies [1]. Especially the retail industry is highly affected by the digital transformation, as new information technologies feature additional channels for consumers to conveniently purchase goods of all kinds [2]. However, while general e-commerce in Germany is rapidly evolving, compared to other nations like France, the UK or the USA, home delivery of food items (e-grocery) is still highly underrepresented [3]. Despite of having the opportunity to capitalize on existing infrastructure, many retail organizations still lack a comprehensive digitalization strategy and logistics concept for adapting their business models or sales channels [3]. As a result, German consumers rarely engage in e-grocery [4].

Neither mayor brick-and-mortar retail chains like REWE and EDEKA, nor web-only players like AllyouneedFresh.de or myTime.de have yet been able to find an integrated solution for the logistical challenges linked to grocery deliveries, while at the same time fulfilling the needs of their customers [5]. E-grocery leads to new

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distribution channels and business models, which result in different logistics requirements, mainly caused by the necessity to prepackage groceries and deliver them from door to door [3].

Although the importance and development of e-grocery in Germany is growing, related logistics concepts are very heterogeneous – especially within an international scope. Consequently, it is difficult to maintain a sound overview about their characteristics and provide transformation recommendations for retailers in different contexts. Existing studies investigate the potential impact of e-grocery on traffic and emissions [2], synopsize general market characteristics [3 - 5] or aim at developing new solutions for optimizing the operational performance by means of different information systems [6]. Nevertheless, as no consolidated overview about grocery fulfillment concepts exists [7], there is a need for a taxonomy to structure existing models and determine ideal channel structures to foster e-grocery market growth and utilization.

The taxonomy is intended to serve both as academic framework for future systematic investigation and theory development as well as practical guide for organizations when selecting, developing or adapting e-grocery channels. The taxonomic approach aids in identifying relationships between individual fulfillment elements, providing a framework for e-retailers to meet different requirements based on their distinct business environment, while at the same time exploiting business opportunities of digital grocery sales. Correspondingly, this study seeks to answer the following research question:

*Which fulfillment concepts exist in the field of e-grocery and how can the characteristics provided by these concepts be structured and clustered?*

To address this question, we opt to derive a taxonomy for grocery home delivery fulfillment. A taxonomy facilitates the classification and examination of a certain topic, provides a foundation for organizations to select an appropriate strategy and offers valuable insights into potential implications of different concepts that can be addressed in future research and used to identify new policies for e-grocery [8].

In this paper, we first outline a synopsis on the research background of grocery home delivery (Section 2). Subsequently, we conduct a systematic literature review in line with the recommendations of Webster and Watson [9] to identify the entire scope of e-grocery concepts within a national and international context (Section 3). Consistent with our research design, we follow Nickerson et al.'s [10] guidelines to develop a comprehensive taxonomy on the given subject (Section 4) and perform a cluster analysis to identify specific archetypes (Section 5). Finally, we provide a discussion on limitations as well as future research and conclude with our findings (Section 6).

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## 2 Research Background

Since this study deals with developing a taxonomy of e-grocery fulfillment concepts, we first provide an overview about grocery home delivery research and review existing structuring and classification approaches to motivate and position our study.

### 2.1 Grocery Home Delivery

In contrast to stationary grocery shopping, e-grocery purchases are solely made online and delivered or collected within a specified time frame [3]. Within this context, a fulfillment concept describes a set of logistical functions, including back-end activities like picking and packing as well as last mile distribution activities like shipping and product reception, initiated after an order has arrived and required to supply customers with their orders [11]. In line with this definition, e-grocery concepts are occasionally also referred to as strategy, scenario or model in scientific literature [e.g., 21, 35] and employed synonymously in this publication. In contrast, business model and supply chain adaptations exceed dedicated logistics functions and thus are not reviewed.

Overall, most of the recent publications regarding e-grocery deal with assessing, quantifying and benchmarking potential impacts of an increasing e-grocery utilization [12, 13, 16, 17, 19, 25, 27, 30, 31], analyzing the consumer behavior [3, 14, 15, 24], providing a status quo [7, 18, 22, 23, 29] or evaluating the ecologic impact of diverse fulfillment concepts [2, 28]. Concerning logistics, several studies propose, conceptualize or examine different models, whereby manifold publications are directly related to assessing or comparing the individual practical impact [6, 11, 20, 21].

### 2.2 Structuring and Classifying Grocery Delivery Concepts

Since the beginning of the 21st century, the relevance of e-grocery has significantly increased in scientific literature [7]. Nevertheless, during our initial literature review in July 2019, where we scanned e-grocery literature in Google Scholar and AISel with the search phrases (“e-grocery” OR “grocery home delivery” OR “online grocery”) AND (“Classification” OR “Taxonomy” OR “Structure”), we only found a few articles attempting to classify fulfillment concepts within this context.

Kämäräinen et al. [32] have developed a basic overview about the characteristics of existing e-grocers including product range and reception type, while Marchet et al. [33] derived a framework to classify important logistics variables in omni-channel retailing including e-grocery. Additionally, Lim et al. [34] have proposed a classification structure for last-mile logistics models in general, including distribution characteristics related to grocery home deliveries, while Hübner et al. [21] outline a strategic planning framework for last mile order fulfilment and delivery. These contributions are the most comprehensive ones in terms of classification, framework design and references. However, they solely focus on last-mile distribution attributes and therefore lack additional fulfillment elements (e.g., shipping mode), crucial for

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establishing e-grocery business channels [4]. Overall, we were not able to identify a publication that provides a consolidated structure for e-grocery fulfillment concepts. Hence, to provide a uniform overview and aid in the digitalization of the grocery sector, we aim to close existing research gaps by developing a granular taxonomy in the field of grocery business.

## 3 Research Design

To answer our research question, we utilized a three-stage research design. First, we conducted a literature review in order to identify relevant e-grocery logistics concepts and their characteristics (Phase 1). Secondly, we employed the rigorous guidelines from Nickerson et al. [10] to iteratively develop a taxonomy on these concepts (Phase 2). Ultimately, we performed a cluster-analysis to identify certain archetypes (Phase 3).

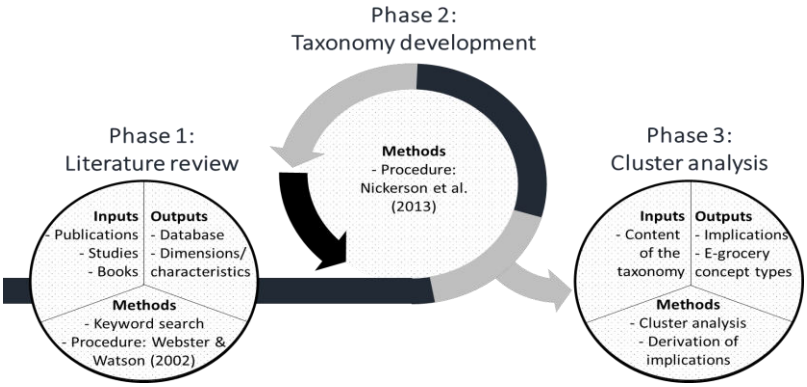


**Figure 1.** Research Design

### 3.1 Phase 1: Systematic Literature Review

The literature review was conducted in line with the recommendations of Webster and Watson [9]. In order to identify relevant scientific literature, we performed search queries in major library catalogues (Table 1).

**Table 1.** Systematic literature search

| *Database* | *Search Term* | *Search Fields* | *Hits* | *Relevant* |
|---|---|---|---|---|
| Google Scholar | ("e-grocery" OR "home delivery" OR "online food retailing") AND "fulfillment" AND ("strategy" OR "scenario" OR "option" OR "model") | Title, Abstract and Keywords | 778 | 24 |
| AISeL | | | 193 | 9 |
| BASE | | | 22 | 2 |
| | | | Sum | 35 |
| | | | Backward search | 6 |
| | | | Forward search | 4 |

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| | |
|---|---|
| Research background | 11 |
| **Total** | **56** |

For selecting relevant sources, we employed the following inclusion criterion: In line with our main objective to identify sources supplying potential dimensions or characteristics on different e-grocery concepts, we only included papers that explicitly focus on grocery deliveries as well as fulfillment and therefore excluded articles related to general e-commerce or internet business. Moreover, we analyzed citations from the identified literature to determine less recent publications (backward search), assessed citation indices to find articles quoting the key publications identified in earlier stages of the review (forward search) and integrated literature considered for the research background in the review process. Eventually, we considered 56 scientific sources (three books, 12 book chapters, 11 conference proceedings and 30 journal publications).

### 3.2 Phase 2: Taxonomy Development Approach

For developing the taxonomy, we applied the approach suggested by Nickerson et al. [10], which is frequently used in Information Systems (IS) research (Figure 2).

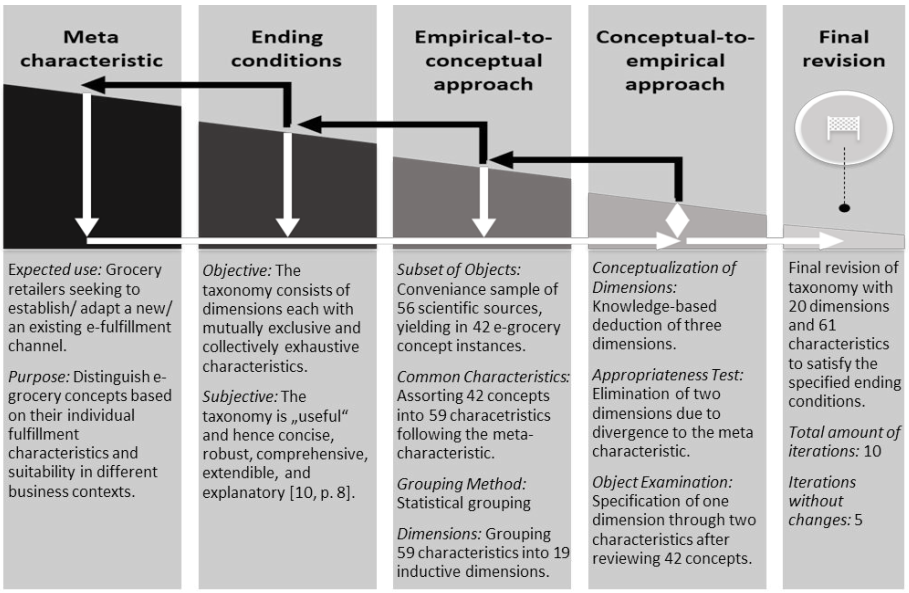


**Figure 2.** Taxonomy development approach

To assist retail organizations to digitally transform their business models by providing a comprehensive classification of available e-fulfillment concepts, the *meta characteristic* for the taxonomy was selected. We adopted the *objective and subjective ending conditions* from Nickerson et al. [10] and started the taxonomy

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development by following an *empirical-to-conceptual approach* in order to inductively gather relevant knowledge in the given research topic. A convenience sample yielded 42 case-related instances of e-grocery fulfillment studied in 56 papers, which we subsequently grouped into characteristics and dimensions. Both the individual set of fulfillment elements as well as the respective providers were added to a research database. To allow for a clear distinction, all provider instances were marked with a country shortcut and, in case of instance duplicates, a time stamp. Moreover, a *conceptual-to-empirical approach* was followed to deductively derive more relevant characteristics and dimensions.

In accordance with the iterative development approach suggested by Nickerson et al. [10], we have conducted ten iteration runs. The first iteration cycle (*empirical-to-conceptual*) dealt with randomly analyzing ten of 42 instances and resulted in an initial set of nine dimensions from 26 characteristics [11, 20, 27, 28, 29, 30, 34, 35]. In the second iteration, leading to seven additional dimensions and 23 characteristics [21, 31, 32, 36], and the third iteration, resulting in two dimensions and six characteristics [6, 37, 38], again ten instances each were analyzed. Finally, in the fourth cycle, the remaining 12 instances yielded one new dimension and four characteristics [39].

| Dimensions | | Delivery area | Fulfillment model | Reception type | Operation model | Demand matching | Stock point | Delivery lead time | Delivery charges | Reattemp. delivery | Delivery provider | Delivery timing | Return procedure | Fleet | Product selection | Order threshold | Picking automation | Picking integration | Picking method | Routing procedure | Routing software |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Iteration 1 | E2C | | 6 | 4 | 2 | | | 3 | 2 | | 2 | 2 | | | | | | | 2 | | 3 |
| Iteration 2 | E2C | 4 | | 1 | | 3 | | | | | 1 | | 4 | 2 | | 2 | 3 | 3 | | | |
| Iteration 3 | E2C | | | | | | | | | 3 | | 1 | | | | | | | | | |
| Iteration 4 | E2C | | | | | | 3 | | | | | | | 1 | | | | | | | |
| Iteration 5 | C2E | | | | | | | | | | | | | | 2 | | | | | | |
| Iteration 6 | E2C | | | | | | | | | | | | | | | | | | | | |

Caption: New dimension from current iteration including number of characteristics
Number of new characteristics from the current iteration
**# Total dimensions: 20**
**# Total characteristics: 61**

**Figure 3.** Iterative development process of taxonomy dimensions and characteristics

For the fifth iteration cycle, we adopted a *conceptual-to-empirical* approach to derive dimensions and characteristics based on knowledge acquired in the course of the review phases. Here, we deduced three mutually exclusive dimensions based on nine characteristics. Due to a lack of appropriateness concerning the specified meta-characteristic, hereupon, two dimensions and seven characteristics (business model: *drop shipping, delivery only, third party, integrated, multi-channel;* pricing model: *dynamic, fixed)* were eliminated. Subsequently, the entire research team consolidated the results of the iteration phases and structured the taxonomy (iteration 6). Furthermore, two members of the team independently investigated and classified all e-grocery fulfillment concepts to contribute to the robustness. After the sixth iteration, all fulfillment instances from the database were successfully classified. Table 2

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displays the grocery providers that have been identified during the literature review, added to the database and analyzed to derive concept instances for the taxonomy.

**Table 2.** Grocery provider instances

| Country | Grocery provider |
|---|---|
| AUS | Coles, Greengrocers, Woolworths |
| FI | Eurospar, Ruok@net, Ruokamarkkinat Oy, S-Kanava, Ykköshalli |
| OTHER | Albert Heijn (NL), Auchan (FR), BİM A.Ş (TU), Carrefour (FR), Disco (ARG), ICA (SE), LeShop (CH), Migros (CH), MyWays (SE), REWE Digital (DE), Shopwings (DE), Wellcome (TW) |
| UK | ASDA (2000), ASDA (2010), Ocado, Safeway, Sainsbury (2000), Sainsbury (2010), Tesco (2000), Tesco (2010), Waitrose |
| US | Amazon Fresh, Borders, FreshDirect, GreatFood, Instacart, Kroger, NetGrocer, Peapod, Shoplink, Streamline, Walmart, Webvan, Whole Foods Market |

In order to retain mutually exclusive and collectively exhaustive characteristics, in the case of *reception type*, we invariably selected the main instance by the given utilization rate of the characteristic (e.g., home delivery instead of click and collect).

### 3.3 Phase 3: Cluster Analysis

To empirically identify e-grocery archetypes, we followed a two-step clustering process. Clustering is a commonly applied practice in IS research for grouping certain objects and investigate correlations in samples [40]. In line with the recommendations of Punj and Stewart [41], we started to define the number of required clusters with Ward's hierarchical clustering method [42], before we applied an iterative portioning approach (k-means). Correspondingly, the reviewed fulfillment providers act as objects and the set of characteristics from the taxonomy as clustering variables.

**Step 1:** Ward's method takes into account the heterogeneity in the groups to which all objects of a group contribute evenly according to their distance from the group's center of gravity and hence, is an idle process for cluster identification. Moreover, it forms convex groups and favors a uniform occupation of groups [63]. With this method, we clustered the e-grocery providers and followed the sequence in which the subsets have been united in relation to the distances by plotting a dendrogram[1]. Ultimately, it indicated that six clusters would be most suitable within the context of our research.

**Step 2:** We employed a k-means algorithm with the identified number of clusters [43]. In order to improve accuracy and avoid poor clustering results, we chose the initial clusters applying *k-means++* and implemented 20 different centroid seeds[2]. In total, the algorithm iterated four times until no significant enhancements were achieved.

[1] Ward's hierarchical clustering was implemented with "SPSS" (Version 26)
[2] K-means and K-means++ was implemented with "R Studio" (Version 1.2.1335)

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## 4 Taxonomy of E-Grocery Concepts

The taxonomy resulting from the research process outlined in section 3 contains 20 dimensions with a total of 61 characteristics. Subsequently, we provide detailed insights into the individual dimensions and outline the corresponding characteristics.

**Delivery area.** While *local* delivery areas feature a limited customer base, companies can benefit from reduced fulfillment complexity and lower investment requirements. In contrast, a *regional*, *national* or an *international* delivery scope offers increased business opportunities, while bearing additional risk factors such as IT-management, process integration and market adaptation [21].

**Fulfillment model.** Grocery firms can decide to use a regional distribution center (*Regional DC*) responsible for supplying goods to several delivery areas or a dedicated distribution center (*Dedicated DC*) assigned to a particular zone. When no DC is to be employed, *store fulfillment* offers the opportunity to pick, pack and ship goods directly from given retail branches. With an urban consolidation center (*Urban CC*), a large amount of products is pre-delivered from another storage location or the manufacturer/ wholesaler to a consolidation center in close proximity to the urban area to be served. In the case of *drop shipping*, orders are directly forwarded to manufacturers or wholesalers, which then take care of the fulfillment. Additionally, many companies also decide for a *hybrid model* (e.g., store fulfillment for high-demand items like groceries and drop shipping for low-demand items like electronics) [11, 20, 35].

| Dimension | Characteristics | | | | | |
|---|---|---|---|---|---|---|
| Delivery area | Local | Regional | National | International | | |
| Fulfillment model | Regional DC | Dedicated DC | Store fulfillment | Urban CC | Drop shipping | Hybrid model |
| Reception type | Delivery box | Pick-up (Integrated / Separate) | Dedicated reception box | Shared reception box | Attended reception | |
| Operational model | Uniform | Collaborative | | | | |
| Demand matching | Accurate forecasting | Supply flexibility | Inventory stockpiling | | | |
| Stock point | Retailer | Wholesaler | Manufacturer | | | |
| Delivery lead time | Same-day | Next-day | More than two days | | | |
| Delivery charges | No additional delivery fees | Additional fees for delivery | | | | |
| Reattempted delivery | No reattempted delivery | Reattempted delivery without extra charges | Reattempted delivery with extra charges | | | |
| Delivery provider | Third-party | Own fleet | Crowd | | | |
| Delivery timing | None | Narrow time windows | Wide time windows | | | |
| Return procedure | No return but money back | Check return at reception | CEP return | Accept and refund in retail outlets | | |
| Fleet | Gasoline vehicles | Electric vehicles | Others | | | |
| Product selection | Integrated selection | Separated selection | | | | |
| Order threshold | No order threshold | Specific order threshold | | | | |
| Picking automation | Manual | Semi-automated | Fully automated | | | |
| Picking integration | Separated | Integrated | Capacity optimized | | | |
| Picking method | Split-case picking | Piece-picking | | | | |
| Routing procedure | Dynamic | Static | | | | |
| Routing software | Commercial | Home-grown | Customized | | | |

**Figure 4.** Taxonomy on e-grocery fulfillment concepts

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**Reception type.** In the case of *attended reception*, deliveries are directly handed over to the customer. *Delivery boxes* are transport cases that can be inter-stored at the reception point for several hours. Moreover, grocery retailers can decide to provide the installation of a *dedicated* or *shared reception box* at the respective household or a shared pick-up point, where e-grocery orders can be collected. Disregarding home deliveries, several retailers solely offer *customer pick-up*. Within this concept, orders are not delivered but provided at an *integrated* (e.g., a designated area of the retail store) or *separated* (e.g., gas station, office complex) location for *customer pick-up* [32].

**Operational model.** E-grocery organizations can engage in *uniform* fulfillment operations, exclusively offering items from the company's supply and production chain. Alternatively, a *collaborative* approach includes the collaboration with external vendors in order to extend the own inventory range [27].

**Stock point.** Depending on the fulfillment model, product inventory can be kept in stock at the premises of the *retailer*, *wholesaler* or *manufacturer*.

**Delivery lead time.** While *same-day* and *next-day* deliveries require huge administrative and logistical efforts, lead times with *more than two days* are easier to manage, even though also negatively affecting the customer satisfaction [35].

**Delivery charges.** Home-delivery services can either be assigned with *no additional delivery fees* or *with additional fees for deliveries*.

**Reattempted delivery.** When selecting *attended reception* fulfillment, retailers need to establish routines for re-attempting deliveries when the initial delivery attempt was not successful. They may choose between offering *no reattempted delivery*, *reattempted delivery without extra charges* or *reattempted delivery with extra charges*.

**Delivery provider.** For the order delivery, providers can use *third-party* service providers or an *own vehicle fleet*. Moreover, with a *crowd* logistics model, private individuals are responsible for deliveries within a sharing economy framework [31].

**Delivery timing.** Timing specifications for deliveries have a huge impact on customer satisfaction. *Narrow time windows* with two or less hours are generally preferred over *wide time windows* with more than two hours and *no* time windows, however, entail additional logistics requirements as well as operational risks [29].

**Return procedure.** A retailer can choose to refuse returns and provide a refund (*No return but money back*), check products at arrival and return them when necessary *(Check return at reception)*, utilize return procedures with a courier, express or parcel service provider (*CEP return*) or handle complaints and refunds at designated retail outlets (*Accept and refund in retail outlets*) [21].

**Fleet.** The delivery fleet may consist of *gasoline vehicles*, *electric vehicles* or *others* (e.g., Drones). The individual composition depends on the delivery provider [39].

**Product selection.** An *integrated selection* features less fulfillment requirements and risks, as the online product portfolio is directly related to the offline portfolio and existing network structures can be leveraged. In contrast, a *separated selection* offers more business opportunities, while requiring new handling and supply routines [38].

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**Order threshold.** Implementing *no order threshold* can result in increased proportionate fulfillment costs, especially for low average basket values. Home-deliveries result in significant logistics costs, which is why retailers might establish a *specific order threshold* to ensure profitability of the fulfillment model [32].

**Picking automation.** Picking in a DC or store can be *manual*, without employing software or electronic equipment to automate the process, *semi-automated*, with software and equipment partially automating the picking process, or *fully automated*, with robotic technologies being implemented to enhance human picking [21].

**Picking integration.** Retailers can choose *integrated picking* to combine online orders with offline orders to utilize existing assets. Moreover, picking can be *separated* from offline channels or *capacity optimized*, where *integrated* and *separated* picking are combined based on order capacities to pool risks and reduce lead-times [21].

**Picking method.** Concerning *split-case picking*, individual items are picked from storage boxes such as bins and consolidated according to customer orders. In terms of *piece-picking*, the responsible staff picks all items required for a particular order [20].

**Routing procedure.** Delivery routes can be adjusted to customer orders and evaluated flexibly to provide *dynamic* routing procedures. Alternatively, routes can be pre-calculated and *static*. Here, a master route acts as predefined routing condition. [6].

**Routing software.** The routing software deployed to generate *static* or *dynamic* routes can be *commercial* or *home-grown*. Additionally, many retailers buy commercial software and adjust it to fit with their individual business situation (*customized*) [35].

## 5 E-Grocery Concept Archetypes

By clustering the given fulfillment concepts from our database, we identified six archetypes. The focal center points of each cluster depend on the dimensions and characteristics of our taxonomy and are both mutually exclusive as well as collectively exhaustive. Hence, we used a cross-tabulator analysis to outline the frequency of a given characteristic within a dimension in terms of percentages (Figure 5). For instance, 67 % of all providers in cluster 1 support store fulfillment, while 33 % rely on integrated fulfillment employing a *regional DC*. The cells in Figure 5 are highlighted in line with the respective share of companies supporting a specific characteristic.

**Archetype 1 – Local heroes (local, uniform fulfillment from stores with customer pick-up).** This cluster contains platforms focusing on e-grocery within a small *regional* area with *store fulfillment*. The main reception form is *customer pick-up* and the fulfillment model is operated *uniformly* with *stockpiling*. Accordingly, the main stock point is the *retailer* and orders can be fulfilled at the *next day*. As delivery services are absent, *no additional order fees* are passed on to the customer and *no order threshold* exists. Retailers in this cluster are ICA SE, Safeway UK, and Webvan US.

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**Archetype 2 – Regional champions (regional, uniform fulfillment from distribution centers with attended reception).** Organizations in this cluster focus on a *regional* and *national* delivery scope. For the order fulfillment, *integrated or dedicated DCs* are utilized and deliveries are only made when customers *attend the product reception*. Stocks are kept at retailer sites and demands are forecasted. For the *attended delivery* services with an *own vehicle fleet*, most companies have set up an *order threshold* and *charge an additional fee*. In return, a *narrow delivery time window*, *return services at reception* and an *integrated* product selection are offered. The picking automation is *fully-automated*, while both *integrated* as well as *separated* picking integration exist. Firms representing this archetype are Auchan FR, Carrefour FR, Coles AUS, Kroger US, Migros CH, Peapod US, REWE Digital DE, Sainsbury UK (2010), Tesco UK (2000), Tesco UK (2010), Wellcome TWN and Whole Foods Market US.

**Archetype 3 – Collaboration experts (large delivery area, collaborative fulfillment with hybrid structures and delivery boxes).** These platforms focus on a large delivery area. To cope with the demand, *hybrid structures*, *collaborative* operations and *delivery boxes* are used. Accordingly, deliveries are performed by *third-party providers* or the *crowd* and returns are primarily handled by *CEP providers*. This enables providers to offer *same-day deliveries* with *narrow time windows*. Demand is matched in terms of *flexible supplies* and, depending on the nature of the orders (e.g., perishables), reattempted deliveries are offered *with or without extra charges*. In line with the *collaborative* approach, the picking is *separated*, using different methods and automation degrees. Organizations in this cluster are Amazon Fresh US, Instacart US, MyWays SE, NetGrocer US, Shopwings DE and Walmart US.

**Archetype 4 – National players (national and international fulfillment with attended reception and separated product selection).** In this cluster, e-grocers like Albert Heijn NL, ASDA UK (2000), ASDA UK (2010), FreshDirect US, GreatFood US, Greengrocers AUS, Ocado UK and Ruok@net FI mainly provide *national* fulfillment with *attended reception*. To cover the delivery scope, different fulfillment models with *collaborative* operations, *accurate forecasting* and *supply flexibility* are utilized. Lead-times are generally *one day* and stock points are shared between *retailers* and *manufacturers*. Accordingly, return services are often absent, while customers still get their *money back* and product selection as well as picking integration are *separated*.

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| Dimension | Characteristic | Archetype | | | | | |
|---|---|---|---|---|---|---|---|
| Cluster and total amount of instances (i) | | 1 (3) | 2 (12) | 3 (6) | 4 (8) | 5 (4) | 6 (9) |
| Delivery area | Local | 67% | 0% | 0% | 13% | 0% | 11% |
| | Regional | 33% | 58% | 33% | 13% | 50% | 56% |
| | National | 0% | 42% | 33% | 63% | 50% | 33% |
| | International | 0% | 0% | 33% | 13% | 0% | 0% |
| Fulfillment model | Integrated DC | 33% | 33% | 0% | 13% | 0% | 0% |
| | Dedicated DC | 0% | 50% | 0% | 38% | 100% | 11% |
| | Store fulfilment | 67% | 8% | 33% | 0% | 0% | 56% |
| | Hybrid model | 0% | 8% | 67% | 25% | 0% | 33% |
| | Urban CC | 0% | 0% | 0% | 0% | 0% | 0% |
| | Drop shipping | 0% | 0% | 0% | 25% | 0% | 0% |
| Product reception | Delivery box | 0% | 0% | 67% | 0% | 25% | 0% |
| | Pick-Up | 67% | 0% | 0% | 0% | 0% | 0% |
| | Shared reception box | 0% | 0% | 0% | 0% | 0% | 0% |
| | Dedicated reception box | 0% | 0% | 0% | 0% | 75% | 0% |
| | Attended reception | 33% | 100% | 33% | 100% | 0% | 100% |
| Delivery operation | Uniform | 100% | 83% | 17% | 38% | 100% | 100% |
| | Collaborative | 0% | 17% | 83% | 63% | 0% | 0% |
| Demand matching | Accurate forecasting | 0% | 50% | 0% | 50% | 75% | 11% |
| | Supply flexibility | 33% | 33% | 83% | 50% | 25% | 11% |
| | Inventory stockpiling | 67% | 17% | 17% | 0% | 0% | 78% |
| Stock point | Retailer | 100% | 100% | 100% | 0% | 100% | 100% |
| | Wholesaler | 0% | 0% | 0% | 63% | 0% | 0% |
| | Manufacturer | 0% | 0% | 0% | 38% | 0% | 0% |
| Delivery lead time | Same-day | 0% | 0% | 100% | 0% | 0% | 0% |
| | Next-day | 100% | 100% | 0% | 88% | 25% | 67% |
| | More than two days | 0% | 0% | 0% | 13% | 75% | 33% |
| Delivery charge | Additional fees for delivery | 0% | 100% | 100% | 100% | 100% | 100% |
| | No additional delivery fees | 100% | 0% | 0% | 0% | 0% | 0% |
| Delivery attempts | Max. one | 67% | 50% | 0% | 25% | 100% | 89% |
| | Reatt. deliveries without extra charges | 33% | 25% | 50% | 38% | 0% | 11% |
| | Reatt. deliveries with extra charges | 0% | 25% | 50% | 38% | 0% | 0% |
| Delivery provider | Third party | 67% | 25% | 50% | 13% | 0% | 33% |
| | Crowd | 0% | 0% | 50% | 0% | 0% | 0% |
| | Own fleet | 33% | 75% | 0% | 88% | 100% | 67% |
| Delivery timing | No | 67% | 0% | 0% | 0% | 75% | 0% |
| | Wide time windows | 0% | 0% | 0% | 13% | 25% | 78% |
| | Narrow time windows | 33% | 100% | 100% | 88% | 0% | 22% |
| Returns | No return but money back | 0% | 0% | 0% | 50% | 75% | 33% |
| | Check return at reception | 33% | 67% | 0% | 50% | 0% | 67% |
| | CEP Return | 0% | 25% | 83% | 0% | 25% | 0% |
| | Accept and refund in retail outlets | 67% | 8% | 17% | 0% | 0% | 0% |
| Fleet | Gasoline vehicles | 100% | 100% | 100% | 100% | 100% | 100% |
| | Electronic vehicles | 0% | 0% | 0% | 0% | 0% | 0% |
| | Others | 0% | 0% | 0% | 0% | 0% | 0% |
| Product selection | Integrated selection | 67% | 92% | 17% | 13% | 0% | 89% |
| | Separated selection | 33% | 8% | 83% | 88% | 100% | 11% |
| Order threshold | No order threshold | 0% | 92% | 50% | 88% | 25% | 100% |
| | Specific order threshold | 100% | 8% | 50% | 13% | 75% | 0% |
| Picking automation | Manual | 67% | 0% | 0% | 13% | 0% | 33% |
| | Semi-Automated | 0% | 17% | 50% | 38% | 0% | 67% |
| | Fully Automated | 33% | 83% | 50% | 50% | 100% | 0% |
| Picking integration | Separated | 33% | 33% | 83% | 63% | 75% | 11% |
| | Integrated | 67% | 42% | 17% | 25% | 0% | 89% |
| | Capacity Optimized | 0% | 25% | 0% | 13% | 25% | 0% |
| Picking methods | Split-case picking | 33% | 58% | 50% | 50% | 25% | 44% |
| | Piece-picking | 67% | 42% | 50% | 50% | 75% | 56% |
| Routing | Dynamic | 100% | 100% | 100% | 75% | 25% | 33% |
| | Static | 0% | 0% | 0% | 25% | 75% | 67% |
| Routing software | Commercial | 0% | 25% | 33% | 13% | 0% | 56% |
| | Home-grown | 100% | 50% | 50% | 50% | 75% | 11% |
| | Customized | 0% | 25% | 17% | 38% | 25% | 33% |

**Figure 5.** Cross-tabulator analysis on clustering results

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**Archetype 5 – Automation enthusiasts (regional and national fulfillment with automated distribution centers and unattended reception).** Within this group, which includes LeShop CH, Shoplink US, S-Kanava FI and Streamline US, a large delivery area is served by using *regional DCs* with *fully-automated picking* facilities and *uniform* operations. Companies deploy unattended reception, either by making use of *delivery boxes* or *dedicated reception boxes*. While demands are mainly *forecasted*, stocks are kept at *retailer* sites. Because of the fulfillment and reception set-up, delivery lead-times are comparably *long* with *no time-window specification*. In return, reattempted deliveries are not required, *no order thresholds* are given and returns mostly handled by offering *money-back services*. Orders are *picked by piece* and the product selection is *separated*.

**Archetype 6 – Store proponents (regional fulfillment from stores with attended reception and semi-automated picking).** Here, orders are fulfilled from *stores* or by using *hybrid structures* and reception is exclusively *attended*. In accordance, demand is often matched by *stockpiling inventory* at *retailer* sites and offering an *integrated* product selection. Delivery lead times exceed one day and generally only *one delivery attempt* is made. Orders are picked *integrated* and *manually* or *semi-automated* from an *integrated* product selection and different routing software is occupied. Providers in this cluster are BİM A.Ş TU, Borders US, Disco ARG, Eurospar FI, Ruokamarkkinat Oy FI, Sainsbury UK (2000), Waitrose UK, Woolworths AUS and Ykköshalli FI.

## 6 Discussion and conclusion

In this contribution, we analyzed available grocery fulfillment models and derived a comprehensive taxonomy as well as several archetypes, offering many applications for academia and practice. The scope of this study is limited to fulfillment concepts and items in the e-grocery business. To provide a detailed overview, selected providers and concept instances deployed for the development of our taxonomy are not limited to a certain geographical region. Moreover, both recent data on existing provider platforms as well as historic data on e-grocery companies not actively pursuing grocery business anymore was used in our study. While this approach ensures a broad set of relevant information, it also requires grocery companies to thoroughly investigate their individual business environment when employing the taxonomy to digitally transform their activities in terms of e-grocery. Additional influencing factors like costs, available infrastructure and regulative standards need to be assessed before specifying or choosing a fulfillment concept (archetype) [35]. Therefore, our taxonomy does not aim at providing general guidelines or best practices, but serves as important first step when it comes to investigating in how far the digitalization changes logistics practices in the grocery industry and offers a valuable starting point for organizations planning to expand their service and business proposition [21]. Consequently, by defining the desired characteristics along the 20 dimensions and selecting an appropriate set-up, the taxonomy can be occupied to select a fulfillment concept for a specific use case.

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Our e-grocery taxonomy has been designed to understand and delineate fulfillment concepts and thus does not explain platforms and individual characteristics in great detail. Nevertheless, it is a useful tool to understand the nature of the objects from our study, which is, according to Nickerson et al. [10], one of the main characteristics of a taxonomy. In contrast to existing literature [e.g., 3, 20, 39], we introduced a standardized terminology as well as distinctive characteristics, dimensions and archetypes, practically aiding in the selection of suitable logistics concepts. Moreover, our taxonomy contributes to mitigate the diversity in e-grocery fulfilment and serves as theoretical framework to guide and organize e-grocery provision in the future. By establishing clearer definitions of fulfillment elements, characteristics, dimensions and concepts, the taxonomy takes into account relevant aspects of digital platform research [44]. However, even though we initially demonstrated its usefulness, it can still benefit from an additional validation and expansion in future research. As we did not systematically assess interdependencies in this research, it might be possible that some dimension mutually exclude each other, which should be investigated in the future.

Ultimately, we created a taxonomy of e-grocery fulfillment concepts with a total of 20 dimensions and 61 characteristics. Based on literature and fulfillment instances, a comprehensive database was created to develop a useful taxonomy for transforming business activities of grocery providers. While a taxonomy with a low number of dimensions and characteristics ensures simplicity and clarity [10], it also lacks descriptive power by neglecting relevant design elements, consequently decreasing its value as evaluation tool for decision makers [45]. Hence, in line with our motivation to support the digital transformation of logistics activities in the grocery sector, we decided to retain the given number of dimensions and characteristics to foster the descriptive value of our taxonomy. Additionally, we applied a cluster analysis to identify six archetypes of grocery fulfillment, which in turn provide insights into the strategies and design decisions of different retailers. As a result, our research provides a valuable contribution to the state-of-the-art for the digitalization in the grocery sector.

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