

eCommerce Supply Chain Insights in Groceries and Consumer Packaged Goods in the United States February 2015

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Introduction

eCommerce sales in the United States in the 12 months ending September 2014 were approximately \$300 billion, representing approximately 6% of total retail sales of approximately \$5 trillion.¹ In some sectors, for example, office supplies, eCommerce now accounts for approximately 50% of total sales. Furthermore, eCommerce is growing at an annual rate of approximately 15%, on pace to double roughly every five years. Retailers in nearly every sector are investing in capabilities to meet the growing shopper demand to purchase goods via eCommerce, with a variety of new business models emerging.

eCommerce in the grocery and consumer packaged goods (CPG) sector, however, is lagging. eCommerce currently only accounts for about 3% of total sales, even though the sector as a whole is substantial, with total annual sales of approximately \$600 billion.² Although the proportion of sales in this sector completed via eCommerce is relatively small, it is generally believed that eCommerce grocery/CPG will continue to grow rapidly across all eCommerce retailers, including pure play and brick and mortar stores. Brick and mortar retailers that also have eCommerce operations are moving toward an Omnichannel strategy, with seamless integration of brick and mortar and eCommerce operations.

The present research study focuses on the *distribution logistics* within the grocery/CPG sector. Many systems exist across eRetailers; they all have different cost structures and are attractive to shoppers on different levels. The common thread woven through all these systems, however, is that *currently, it is exceedingly difficult to make these systems profitable*. As such, the present study aims to answer four key questions:

1. What is required to make these eCommerce/Omnichannel systems profitable?
2. As the volumes of eCommerce grows over the next few years, how will the economics of these systems evolve?
3. What innovations in the supply chains of these systems will help improve profitability?
4. How does the perception and preference of shoppers affect the design and profitability of these eCommerce systems?

To explore and answer these questions, the present research was conducted over the period July to December 2014. Data were gathered from three main sources:

1. **Willard Bishop Micro ABC Model.** Using retailers' brick and mortar and eCommerce operating reports, onsite observations, and industrial engineering time and motion studies, Willard Bishop identified 28 major processes and activities that directly support eCommerce programs in distribution centers (DCs), dark stores, and live stores across six retail chains: five local/regional grocery brick and mortar retailers and one regional pure play eRetailer. These processes and activities were used to determine the cost to pick and fulfill online grocery orders across seven different eCommerce programs (see box). Willard Bishop also leveraged eCommerce transaction data from their 2015 eCommerce ABC Standards research to determine average order size and product mix across the various programs. All conclusions are based on the six participating retailers cost data and demographics. Although this sample is representative of today's eCommerce programs at brick and mortar locations, results will vary by eRetailer and by supply chain.
2. **Online survey of eCommerce shoppers, with 1,986 respondents (US adults), conducted by the University of Michigan.** The survey was conducted in September 2014 using the online platform instant.ly by uSamp.

Survey respondents were members of uSamp's house panel, and demographic analysis of the respondents indicates they are representative of US adults in terms of age, income, and race/ethnicity.

- 3. Macro cost model using computer simulation, built and modeled by the University of Michigan research team.** The UM team built a large-scale computer simulation model that incorporates many of the process identified in the Willard Bishop micro ABC cost model. This simulation model serves as a test bed for supply chain innovations (detailed later in this report). In addition, we also used simple accounting calculations to project costs under simple scenarios that do not require simulation, such as the effect of increasing volume.

Our unique three-pronged research methodology—combining a field-based ABC cost model, a shopper preference survey, and a macro simulation model—to test scenarios and supply chain innovations allows us to obtain detailed insights at multiple levels. Our main findings are highlighted below.

Executive Summary

Below are the highlights of our research:

1. As currently structured, all eCommerce systems in the grocery/CPG sector are barely profitable when only direct going costs are considered. If indirect startup costs are also included, these systems actually operate at a *loss*. In general, the three largest cost drivers are delivery expenses, store/warehouse picking labor, and occupancy.
2. *In-vehicle pickup at store* and *van delivery from DC* in high-density markets were the most cost-efficient delivery systems found in the present study. If the shopper pays shipping costs, parcel delivery from the DC is also cost efficient. Minimizing touches in the supply chain, increasing order size, and increasing the number of deliveries per van route are all key enablers to improving cost efficiency.
3. Shoppers see value and are willing to pay for the convenience of these services. A majority of shoppers consider \$6 to \$10 a reasonable fee for delivery to their homes, and \$3 to \$5 for in-vehicle or in-store pickups. For all methods of pick up, shoppers do, however, expect their products relatively soon (6 hours or less), with very few willing to wait until the next day.
4. Tremendous market potential exists within the eCommerce in the grocery/CPG sector, with shoppers willing to increase their spending significantly in this channel, but only if the right kind and right priced distribution systems are available. At the \$5 price point, approximately 80% of shoppers stated they will either increase the amount or remain at the same level of grocery/CPG shopping they do via eCommerce.
5. As projected volumes increase and operations become more efficient, there is an increased opportunity for profitability within these distribution systems. We project that at a 15% annual growth rate in volume and 1% annual cost reduction rate, unit profit margins of eCommerce models in the grocery/CPG sector can achieve profit in the 12% to 15% range.
6. Some supply chain innovations, such as shifting fast-moving items to a wareroom if store fulfillment is used or using larger vehicles to complete more deliveries per trip, offer greater opportunities for cost savings. For example, combining both the wareroom with larger vehicles and assuming a doubling in volume over five years, the van delivery from store model progresses from being marginally unprofitable to a profit margin of approximately 11% to 15%.

eCommerce Programs

Although some early pioneers in eCommerce have walked away due to challenging economics, an entirely new group of eRetailers are jumping into the online grocery arena, and new programs are emerging. Shoppers can now have their online purchases delivered to their homes by 7 a.m. or throughout the day with shorter delivery windows, most being around two hours. Shoppers can also pick up their online orders at their local supermarket without getting out of their car, or they may opt to have items shipped or delivered directly to their home. Some shoppers are even choosing the newest service: personal shoppers. A shopping concierge will handle the actual shopping, then deliver purchases to shoppers' homes.

Two broad types of eCommerce businesses operate today, each providing shoppers with different online options and experiences. They are:

1. **Pure Play eRetailers** are the dot-com retailers, such as Amazon.com, Drugstore.com, and Diapers.com. Pure play eRetailers do not have retail store fronts, and they fulfill and ship orders from centralized warehouses and distribution centers. For consumables, Amazon, NetGrocer, USGrocer, and ShopFoodEx are leading the charge.

While most pure play businesses ship online orders via mail or a small package carrier today, a few are experimenting with van deliveries. Amazon Fresh, for example, is providing van deliveries in Seattle, San Francisco, Los Angeles, San Diego, and now New York. They are taking on a successful local pure play home delivery business named FreshDirect.

2. **Brick and Mortar Retailers** are primarily retailers with physical locations that have jumped into the online grocery/CPG business. They include Walmart, Target, and leading supermarkets such as Ahold (Peapod), Safeway, Giant Eagle, Harris Teeter, Kroger, Lowes Foods, Roche Brothers, ShopRite, and other strong regional chains. Some of these retailers view eCommerce as just another service and the price of poker, that is, they must participate in order to be relevant with emerging shoppers and their needs. Others believe it is a growth channel and a new source of sales and profits.

Most brick and mortar retailers who now offer online shopping fulfill orders with their own employees. A set of independent eCommerce businesses are emerging, however, that offer personal shopping services. They don't have distribution centers. They don't have physical stores. They are an army of people who provide personal shopping service for buyers. Shoppers place orders directly with these third-party organizations, personal shoppers go to local stores to shop, and then provide same-day deliveries in only a few hours. Instacart, Google Shopping Express, Postmates, and Deliv are example businesses. Some of these businesses have direct relationships with local retailers and essentially serve as their online grocery fulfillment arm; others in turn operate completely independently.

These two approaches to eCommerce operate under very different business models but, they have one thing in common: they are making online shopping more convenient and the fulfillment process easier than ever before.

Two Inventory and Four Delivery Models

Fulfilling online orders requires a source for product and a way to get orders to shoppers. All online orders today are either: (1) picked from a warehouse/distribution center or (2) shopped directly from inventory already in a store.

Store inventory comes mainly from the store shelf. Some companies such as Ahold/Peapod, however, use warerooms at the store that hold separate inventory that is 100% dedicated to fulfilling online orders. This is done mainly to protect against running out of key items that are promoted heavily.

Once eRetailers determine from where they will source their online inventory, they then must decide which delivery method they will use to fulfill the order. Some will only deploy one option, whereas others may offer multiple delivery options at the same location. The four ways eRetailers deliver online orders to shoppers include the following:

1. **Van delivery.** Delivers online orders directly to the shopper's home. This is done usually within a predetermined one- or two-hour delivery window. The delivery can be attended (shopper must be home) or unattended (shopper does not need to be home). If requested, many businesses will actually bring the attended order directly into the shopper's home, not just the doorstep.
2. **In-vehicle pickup.** In the U.S., brick and mortar retailers refer to this program as curbside pickup or express lane pickup. In Europe, they refer to this as the drive model. When orders are ready, shoppers drive to the store, park in an area designated for online orders, and interact with an intercom or terminal. Within five or so minutes, a store clerk arrives at the car and places the order inside the trunk without the shopper ever having to leave his or her vehicle.
3. **In-store pickup.** Similar to the in-vehicle option, shoppers drive to the store to pick up their online order. The difference with in this option, however, is that shoppers must park their vehicle and enter the store to collect their online order. This is usually done at a dedicated area, often by the customer service desk near the front of the store.
4. **Parcel.** Online orders are shipped to the shopper or designated shopper location by one of the major postal carriers: the US Postal Service, UPS, or FedEx. Parcel orders can be fulfilled from a warehouse /distribution center or from the store.

Of the various eCommerce programs that are generally available to brick and mortar retailers, the most prevalent programs offered in the U.S. today are:

1. Warehouse inventory/selection and van delivery to the shopper's home.
2. Store inventory/selection and van delivery to shopper's home.
3. Store inventory/selection and in-vehicle pickup.

A few brick and mortar retailers will ship (via the postal service or small package carriers such as UPS/FedEx) online groceries to a desired location. This option is not very common, however, and not expected to be a major program going forward. In addition, the in-store pickup option is also not as common; indeed, retailers have opted for the more convenient option for families: in-vehicle pickup. This program does not add significantly more operating costs to retailers, and it is more convenient, especially for time-starved parents traveling with children.

For the pure play eRetailers, parcel delivery is currently the predominant fulfillment vehicle. However, Amazon is investing heavily in the van delivery program for their Fresh division and is even running tests with the United States Post Office.³

Current State: Activity-based costing

Activity-based costing (ABC) results were derived from data across five local/regional grocery brick and mortar retailers and one regional pure play eRetailer. All of the eCommerce cost analyses cover a 52-week period (2013/2014) and represent all departments, categories, and online SKUs. Each temperature state (dry, frozen, chilled) of consumables is covered, and all fixed and random weight (produce, deli, fresh meat, etc.) SKUs are included in the analyses.

Currently, brick and mortar retailers operate primarily seven different eCommerce models (a combination of inventory location and delivery method). The straight average eCommerce order across the seven models generates approximately 7.5% profit on a direct basis, assuming the shopper pays the shipping and delivery costs. By

comparison, a brick and mortar supermarket generates a true profit of around 12.5% (excluding indirect costs) on regular, non-eCommerce transactions.

Fully loaded, grocery eCommerce is a money losing business today. On a direct basis, it is profitable.

The fees in the profit and loss table (Table 1) include the shopping charge at the store (typically \$2.95 or \$4.95 per order) and/or the delivery charge (typically \$9.95 to \$11.95) to deliver to the shopper’s home. Without the fees, the eCommerce transaction would be only a break-even proposition—at best.

Table 1.
Average eCommerce P&L per unit in the grocery and consumer packaged goods industry⁴

Average eCommerce P&L per unit sold across seven eCommerce models			The seven eCommerce models Include:
Avg. Retail Price	\$3.25		1. Store inventory/van delivery
Cost of Goods	<u>\$2.28</u>		2. Store inventory/in-vehicle pickup
Gross Profit	\$0.98	30.0%	3. Store inventory/in-store pickup
Fees Paid By Shopper	<u>\$0.22</u>		4. Store inventory/parcel
Adj. Gross Profit	\$1.20		5. D.C. Inventory/Van Delivery
Direct ABCs*	<u>\$0.95</u>		6. DC inventory/parcel
True Profit	<u>\$0.24</u>	7.5%	7. Dark store/van delivery

* Includes direct warehouse, store and eCommerce processes and activities. Excludes eCommerce startup development costs, corporate back office, and overhead costs to manage eCommerce and indirect costs.

Notes: Price is net of all shopper discounts. Cost of goods includes all vendor promotional monies.
Fees includes shopping charges to pick the online order and any van delivery charges.
Parcel does not include third-party costs (e.g., UPS, USPS, FedEx) and assumes the customer pays for this cost.

Source: Willard Bishop 2015 eCommerce ABC Standards

Direct costs include all costs to get the product to the picking location (warehouse or store) and the incremental eCommerce cost to fulfill the online order. This does not include the back-office costs to develop and manage online orders. Back-office costs were excluded from this analysis because many programs are still in their infancy, and it is unfair to burden programs fully with high startup costs, at least until critical mass is reached. Startup costs are often more than \$100,000 per brick and mortar store to launch eCommerce, and corporate overhead (annual back-office costs) averages around 5% of eCommerce sales. In the present study, as many as 28 unique processes and activities were used to generate the direct ABCs across the seven programs.

Table 2.
Average eCommerce P&L per unit sold (direct cost basis) for seven fulfillment models

	Store Inventory Van <u>Delivery</u>	Store Inventory In-vehicle <u>Pickup</u>	Store Inventory In-store <u>Pickup</u>	Store Inventory <u>Parcel</u>	DC Inventory Van <u>Delivery</u>	DC Inventory <u>Parcel</u>	Dark Store Van <u>Delivery</u>	<u>Average</u>
Avg. Retail Price	\$3.25	\$3.25	\$3.25	\$3.25	\$3.25	\$3.25	\$3.25	\$3.25
Cost of Goods	\$2.28	\$2.28	\$2.28	\$2.28	\$2.28	\$2.28	\$2.28	\$2.28
Gross Profit	\$0.98	\$0.98	\$0.98	\$0.98	\$0.98	\$0.98	\$0.98	\$0.98
Fees Paid By Shopper	\$0.20	\$0.11	\$0.20	\$0.50	\$0.13	\$0.25	\$0.18	\$0.22
Adj. Gross Profit	\$1.17	\$1.09	\$1.17	\$1.47	\$1.10	\$1.22	\$1.16	\$1.20
Direct ABCs *	\$1.18	\$0.89	\$0.95	\$1.43	\$0.57	\$0.71	\$0.95	\$0.95
True Profit	-\$0.01	\$0.20	\$0.22	\$0.04	\$0.53	\$0.51	\$0.20	\$0.24
True Margin	-0.2%	6.1%	6.9%	1.1%	16.4%	15.8%	6.3%	7.5%
Fees Used Per Order	\$9.95	\$4.95	\$4.95	\$4.95	\$6.95	\$4.95	\$9.95	
Order Size (units)	50	45	25	10	55	20	55	

* Includes direct warehouse, store and eCommerce processes and activities. Excludes eCommerce startup development costs, corporate back office and overhead costs to manage eCommerce and indirect costs.

Notes: Fees range across retailers and the most common fee shoppers pay was used for this analysis by type of eCommerce program. DC parcel programs generally do not charge a shopping or delivery fee, however, they have higher prices to make up for not charging a fee. A fee was used in this analysis in lieu of higher prices.

Source: Willard Bishop 2015 eCommerce ABC Standards

The most profitable grocery/CPG program (on a direct-cost basis) is the centralized DC/warehouse pick model and van delivery fulfillment program in high-density markets.

The DC van delivery model is the least expensive to operate, because there are no store-level expenses, and orders are fulfilled from one location within a geographic region. Although the last mile can be expensive (all deliveries are out of one location), the DC van delivery model leverages centralized inventory and picking, which significantly limits touch points and offsets the high cost of deliveries. A DC eCommerce program (with or without van delivery) can support hundreds of stores in high population areas; indeed, population density is key. The main cost drivers between DC models and store models are compared in Table 3:

Table 3.
Comparison of DC model and store model on three factors

	Inventory location	Pickers/shoppers	Vehicles
DC model	One inventory location and significantly fewer touch points.	Significantly smaller team with tight pick zones in one location.	One centralized fleet.
Store model	Hundreds of inventory locations (significant duplication), which results in more orders, more handling, and more equipment; essentially, more everything.	Many shopper teams spread across hundreds of stores. This creates more slack in the system and less productive picking/ shopping.	Each store requires a minimum of two-to-three vehicles to cover peak periods. This means a significantly larger fleet, excess capacity, and underused cube.

Although it is more expensive to operate, store models are growing and more popular among brick and mortar retailers because they are easier to startup.

Table 4.
eCommerce true margins for seven fulfillment models with varying order sizes

Sensitivity analysis (average true profit margin after direct ABCs)								
	Store Van <u>Delivery</u>	Store In-vehicle <u>Pickup</u>	Store In-store <u>Pickup</u>	Store <u>Parcel</u>	DC Van <u>Delivery</u>	DC <u>Parcel</u>	Dark Store Van <u>Delivery</u>	<u>Average</u>
True Margin (Avg. Order Size With Fee)	-0.2%	6.1%	6.9%	1.1%	16.4%	15.8%	6.3%	7.5%
True Margin (Fixed Order Size With Fee)	-8.0%	4.6%	7.7%	8.3%	10.6%	15.9%	-3.4%	5.1%
True Margin (Avg. Order Size and No Fee)	-6.3%	2.7%	0.8%	-14.1%	12.5%	8.2%	0.7%	0.6%
True Margin (Fixed Order Size and No Fee)	-14.1%	1.2%	1.6%	-6.9%	6.7%	8.3%	-8.9%	-1.7%
Avg. Order Size =	50	45	25	10	55	20	55	37
Fixed Order Size =	30	30	30	30	30	30	30	30

Source: Willard Bishop 2015 eCommerce ABC Standards

We can also compare the true margins of all seven models, assuming a fixed order size of 30 items. In contrast, in Table 2, we used the actual observed order size for each model. As shown in Table 4, the true margins decrease for models in which the actual order size is larger. For example, for store inventory/van delivery, reducing the order size from 50 to 30 items decreases the true margin from -0.2% to -8%. In addition, we also report the impact of removing the fee completely—as one would expect, this decreases true margins even further.

For the remainder of this whitepaper, we continue with the average order size as determined for each channel as shown in Table 2. In all seven eCommerce models, there are several activities that drive a disproportionate amount of the costs. These cost drivers can vary across each model.

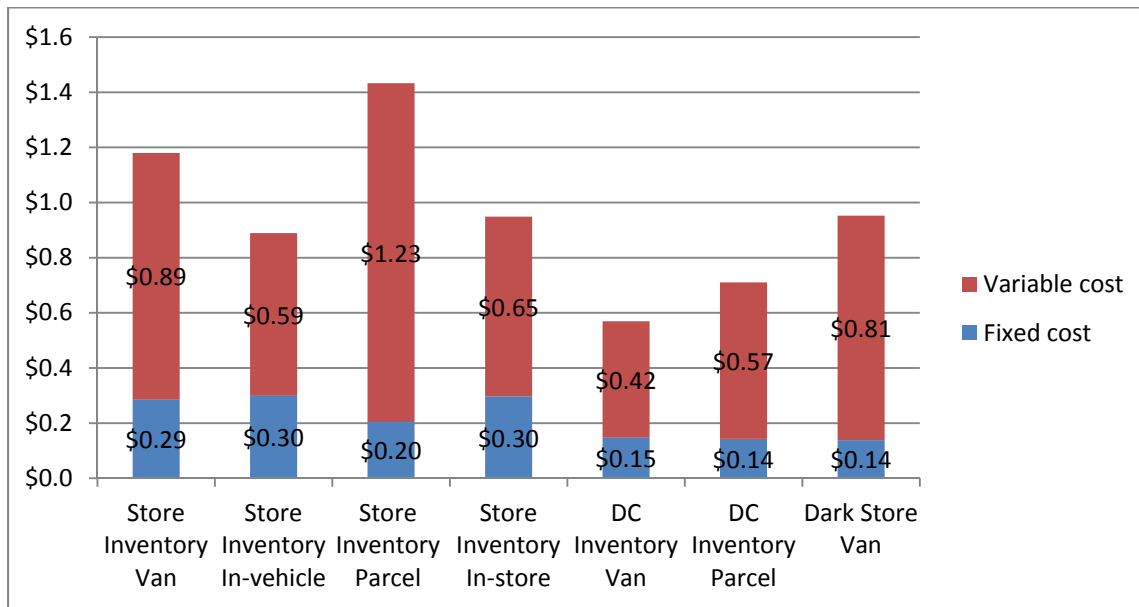
Table 5.
Key cost drivers in grocery/CPG eCommerce fulfillment

	Store Inventory Van <u>Delivery</u>	Store Inventory In-vehicle <u>Pickup</u>	Store Inventory In-store <u>Pickup</u>	Store Inventory <u>Parcel</u>	DC Inventory Van <u>Delivery</u>	DC Inventory <u>Parcel</u>	Dark Store Van <u>Delivery</u>
Fee and Order Size	X	X	X	X	X	X	X
Warehouse Occupancy					14.0%	11.2%	
Store Shopping Labor	21.8%	28.9%	27.1%	17.9%			22.0%
Store Occupancy	17.4%	24.5%	22.9%	9.5%			
Supply Expenses				25.0%		50.4%	
Delivery Expenses	27.0%				39.5%		33.4%
Share of Direct ABCs	66.1%	53.4%	50.0%	52.4%	53.5%	61.6%	55.5%

Notes: Under the store models, retailers still have many of the normal brick & mortar expenses to move product through the warehouse and store, even before the incremental eCommerce activities begin. Under the DC programs, there are no store-level expenses which are significant

Source: Willard Bishop 2015 eCommerce ABC Standards

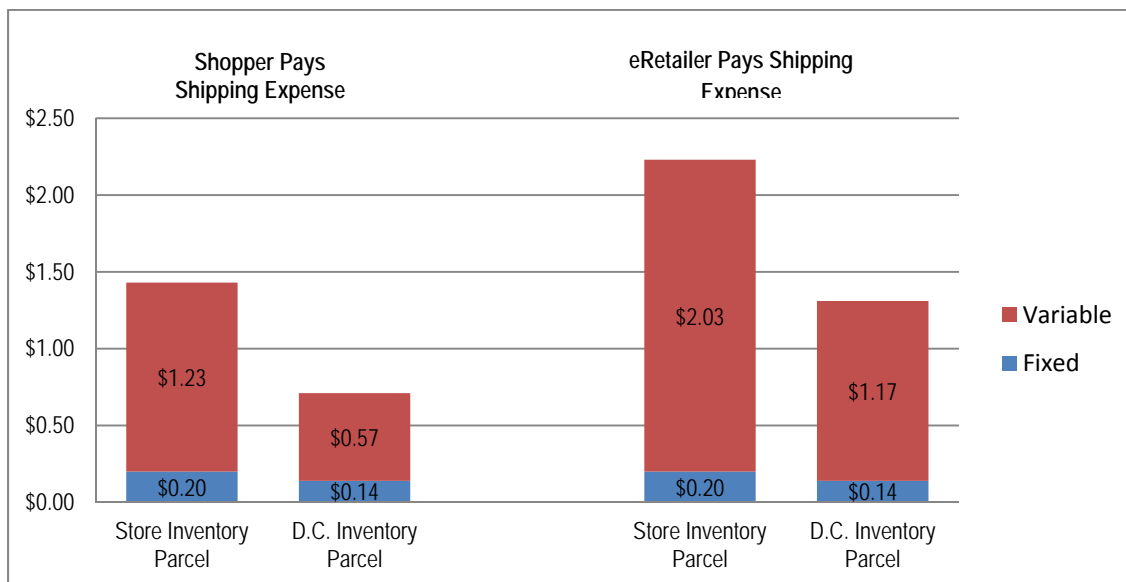
Most of the eCommerce activity based costs eRetailers incur are variable. The model that generates the largest variable costs is the Store Inventory Parcel model.



Source: Willard Bishop 2015 eCommerce ABC Standards

Figure 1.
Fixed and variable cost breakouts of eCommerce models. Parcel models do not include shipping cost.

Figure 1 does not include third-party shipping costs (e.g., UPS, USPS, FedEx) for parcel programs, because it assumes the shopper pays for this expense. For eRetailers that absorb the shipping cost, eCommerce ABCs increase significantly, by \$0.60 to \$0.80 per unit.

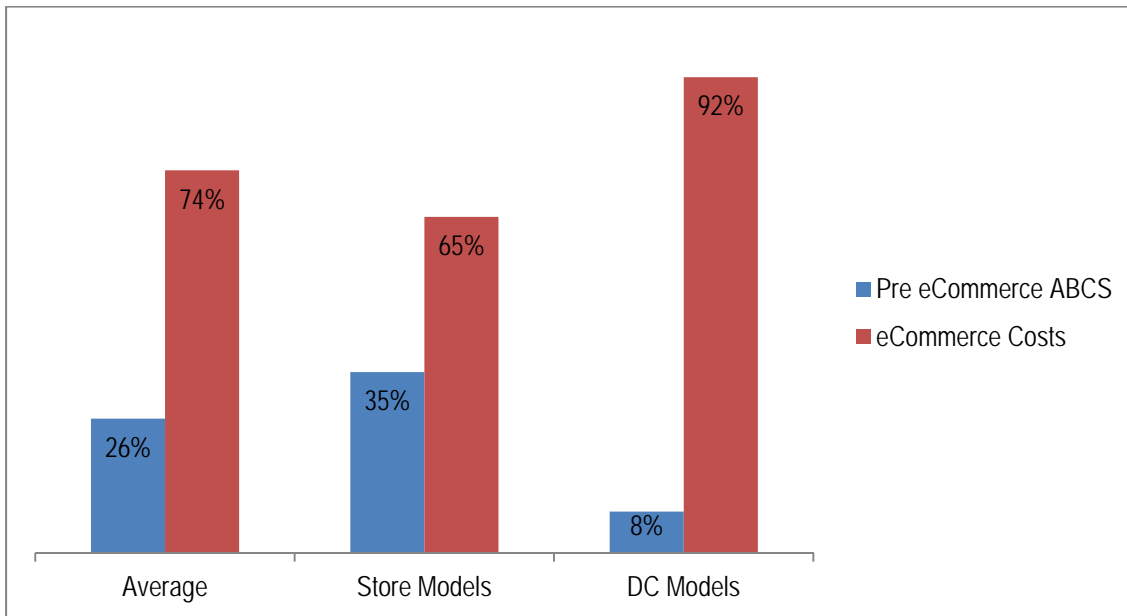


Source: Willard Bishop 2015 eCommerce ABC Standards

Figure 2.
Fixed and variable cost breakouts of Parcel delivery eCommerce models, for grocery/CP

The direct ABCs for eCommerce programs include existing warehouse and store (pre-eCommerce) costs and incremental eCommerce costs. On average, nearly three-quarters (74%) of eCommerce costs are incremental and one-

quarter (26%) represent the pre-order costs to move product through the system before the eCommerce order is placed.



Source: Willard Bishop 2015 eCommerce ABC Standards

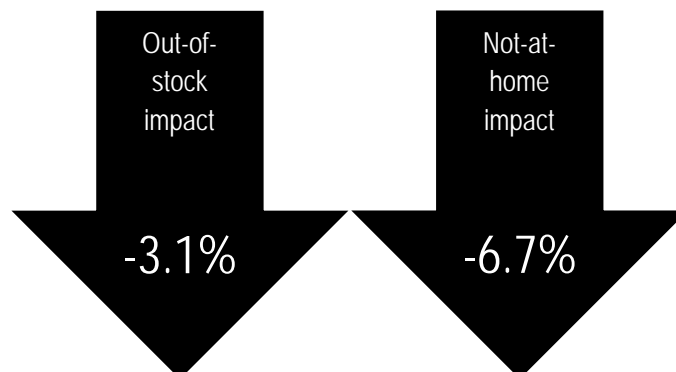
Figure 3.
Where costs build up: Pre-eCommerce and eCommerce cost breakouts of eCommerce models, for grocery/CPG

A higher share of store model costs are generated by pre-activities compared to the DC eCommerce models. Before a store picks an online order, the retailer incurs the cost to get product to the shelf. This usually means covering 100% of the warehouse costs (where applicable) and a majority of the normal brick and mortar store costs. This includes ordering, receiving, putting away, selecting and loading, moving, stocking, rotating, facing, occupancy, and so on.

Out-of-stocks and not-at-home are the two biggest cost issues facing eRetailers and significantly impact the eCommerce P&L.

Calling a shopper because the item he or she selected is not available or driving to a location and discovering the shopper is

not at home and having to modify a route will quickly turn a slightly profitable order into a money losing endeavor. The effort to resolve an out-of-stock item results in a decrease in the true margin per unit by an additional 3.1%. The not-at-home condition results in a 6.7% decrease in the true margin.



These two “exceptions” can have an even greater impact on order profitability than the wages paid to a picker or delivery person and they need to be managed carefully; indeed, out-of-stock challenges are why some eRetailers favor a DC model over a store model.

1. **Reduce Out-of-stocks.** There are two approaches eCommerce programs use to reduce out-of-stocks:
 - a. Retailers can centralize their online inventory. This is done to control promotional out-of-stocks more effectively, which are challenging in an in-store environment. Demand forecasts are getting better, and daily deliveries are more the norm, but this is still a significant issue for brick and mortar grocers. Centralizing inventory either requires a DC pick model or a store wareroom. Warerooms are difficult to manage and require significant backroom space in the store.
 - b. Shoppers can select the option that allows eRetailers to choose alternative product if an item is out-of-stock. Many stores currently offer this feature online. Although it adds costs, it is still less expensive than having to call a shopper to modify an order.
2. **Eliminate the Not-at-Home condition.** Delivery drivers often will call a homeowner 10 minutes prior to their delivery to ensure the person will be home and can accept the delivery. This is especially important for programs with large delivery windows, for example, 2 to 4 hours. Many homeowners don't like to be stuck waiting for a delivery.

What does the shopper want?

The most important voice in the design of distribution systems is, of course, the voice of the shopper. Although there are plenty of shopper surveys that examine various facets of eCommerce in general, very few target the grocery/CPG sector. Therefore, we conducted a survey specifically for the present project in September 2014.⁵ The survey was conducted online, using the instant.ly platform of uSamp. The survey was administered to 1,986 respondents from uSamp's paid panel, in a representative sample of US adults.

Shopper preferences for delivery models

As mentioned, from the shopper's perspective there are several different models in terms of when and how they obtain their goods. In the present study's survey, we tested how much shoppers would be willing to pay for each of delivery methods, as well as how long they'd be willing to wait for their items. We researched four main systems:

1. Van delivery⁶
2. In-vehicle pickup
3. In-store pickup
4. Locker

Three of these are the same as the four listed in the *Introduction*. We did not separately consider parcel fulfillment, because from the shopper's perspective parcel delivery is the same as unattended home delivery. Instead, we added a new category: locker pickup. Here, the retailer deposits the items in a pre-arranged locker. Some companies such as Amazon maintain their own lockers; alternatives include the mail room in apartment complexes or third-party locker services provided by UPS. The shopper gets information via their smart phone about the location of the items and a pass code to open the locker. The shopper then picks up the items at a convenient time. Although we do not have cost data for a locker pick-up model, we could consider researching this in a future study.

Van Delivery

As illustrated in Figure 4, almost 50% of shoppers are willing to pay \$6 to \$10 or more for home delivery. However, a large majority of shoppers (almost 80%) would like the items delivered within four to six hours or less from the time they place the order. There appears to be very little tolerance for a long delay in order delivery and almost no appetite for delivery the next day or later.

This confirms the desire for shoppers to get their items very quickly and supports the trend in the industry of offering same-day delivery services.

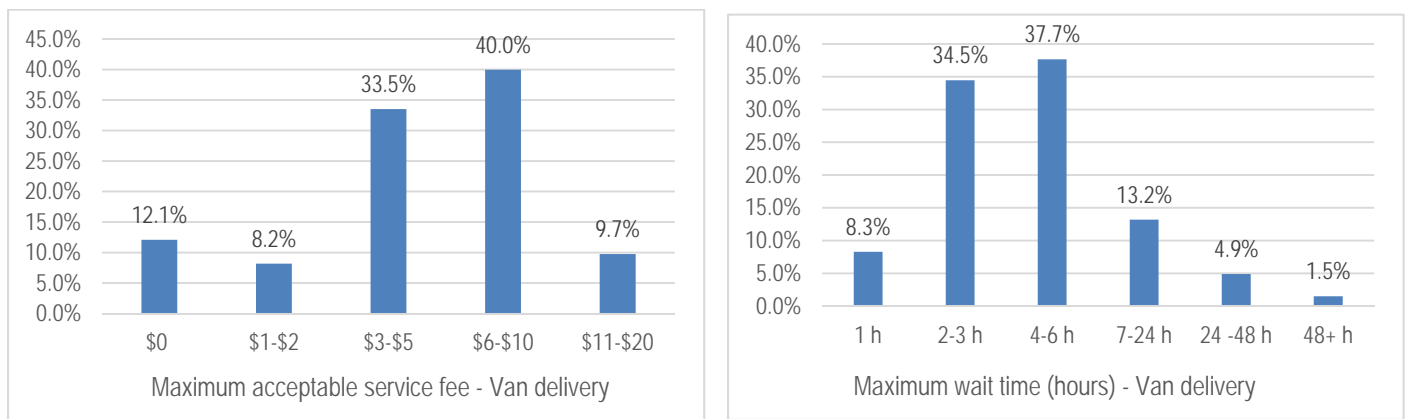


Figure 4. Maximum acceptable levels of service fee and delivery latency for van delivery for grocery/CPG eCommerce orders.

The interesting point to note is that shoppers are indeed willing to pay for this service, with a majority considering paying \$6 or more, and more than 80% willing to pay at least \$3. Given the high operational cost of these delivery systems, our survey suggests that firms should not shy away from charging shoppers for this service.

In-vehicle pickup

Figure 5 shows that for express lane pickup, the acceptable service fee is generally in the \$3 to \$5 range, with more than 70% of shoppers willing to pay no more than \$5. In addition, approximately 67% of shoppers want to be able to pick up their items in three hours or less. These are to be expected; both service fee and time to pickup are lower than in home delivery. Shoppers appear to be implicitly exhibiting some understanding that if they need to pick up their items rather than have it delivered at home, they should be able to do it for a cheaper fee and get it quicker.

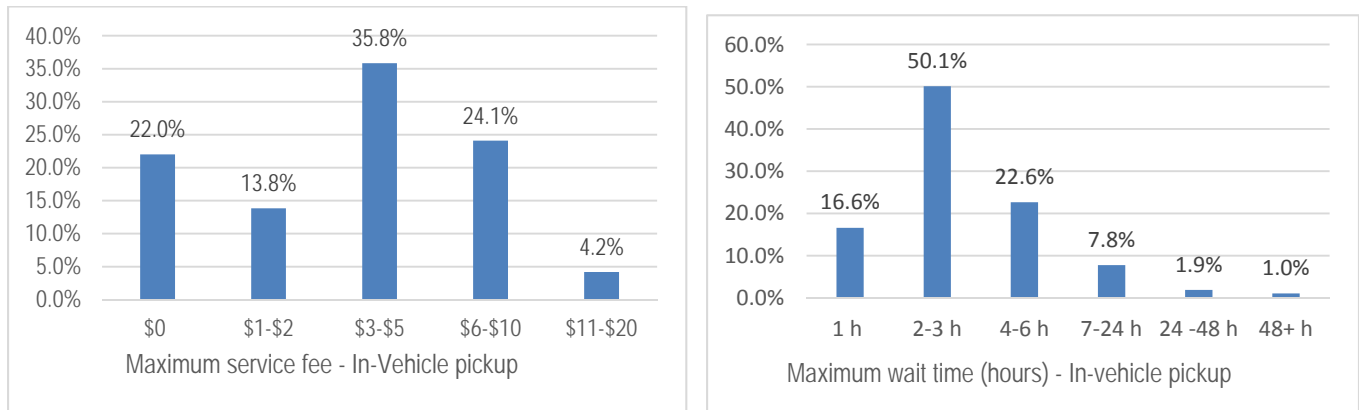


Figure 5. Maximum acceptable levels of service fee and delivery latency for in-vehicle pickup for grocery/CPG eCommerce orders

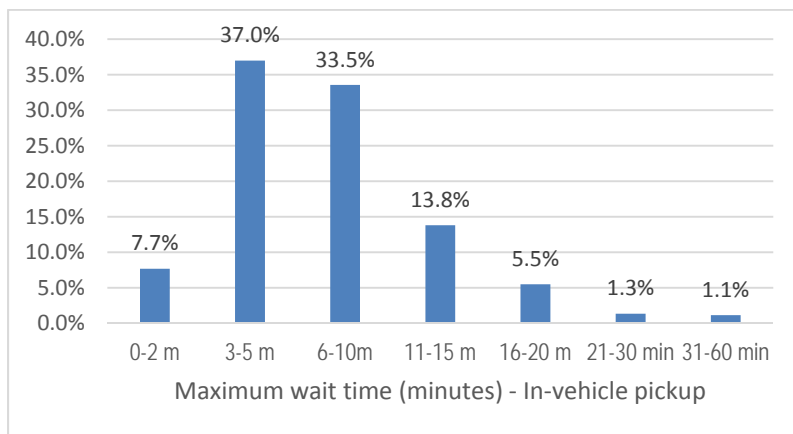


Figure 6. Maximum acceptable wait (minutes) for service for in-vehicle pickup for grocery/CPG eCommerce orders

For in-vehicle pickup, an additional point of attention is the potential wait time in queue at the pickup location. Figure 6 shows that shoppers are willing to tolerate some amount of wait (almost 80% are willing to tolerate 10 minutes), it is undesirable for waits to be significantly longer than that.

In-store pickup

As Figure 7 shows, if the shopper is required to get out of the car and go inside the store to pick up the items, the maximum acceptable service fee is again no more than \$5 for more than 70% of shoppers. This is broadly similar to the express lane responses, as is the maximum acceptable wait time. Again, a majority of shoppers want their items within three hours or less of placing the order.

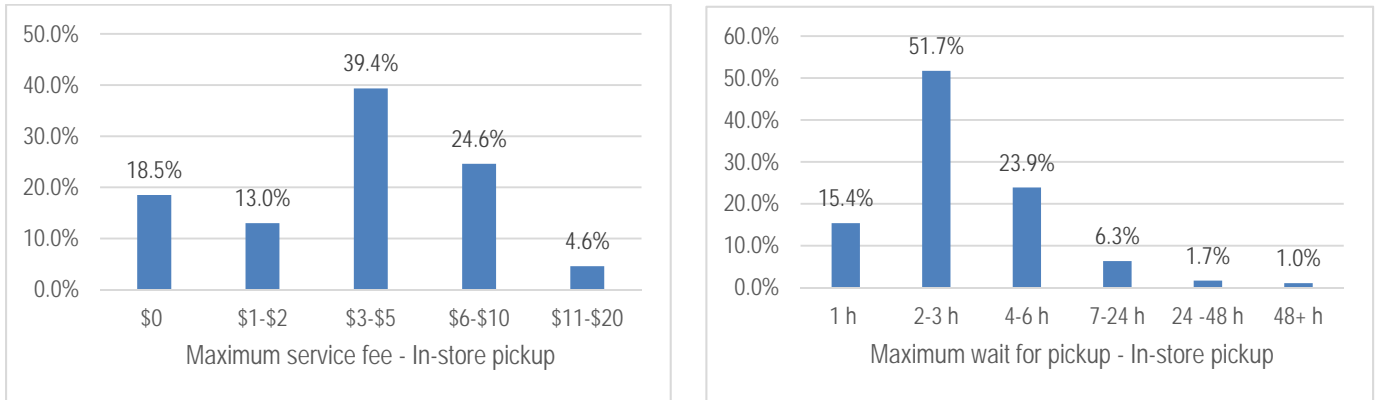


Figure 7. Maximum acceptable levels of service fee and delivery latency for in-store pickup for grocery/CPG eCommerce orders.

Locker pickup

Finally, we also surveyed shoppers about their interest in the locker pickup model. The locker model is relatively new, and consists of the retailer delivering the items to a pre-specified location such as lockers in public transport hubs, the mailroom of an apartment complex, or pick-up stations in retail stores such as Walmart and 7-11 stores.⁷ Lockers are likely to appeal to only a segment of the market. Urban apartment-dwellers who use public transport may find the locker model very attractive, whereas suburban families who use their own cars are unlikely to adopt locker deliveries.

Survey results are broadly similar to the in-store pickup model given the caveat of limited appeal. As Figure 8 shows, approximately 80% of shoppers consider a service fee of no more than \$5 to be acceptable, and 90% of shoppers would want to pick up their items within four to six hours from the time they place their order.

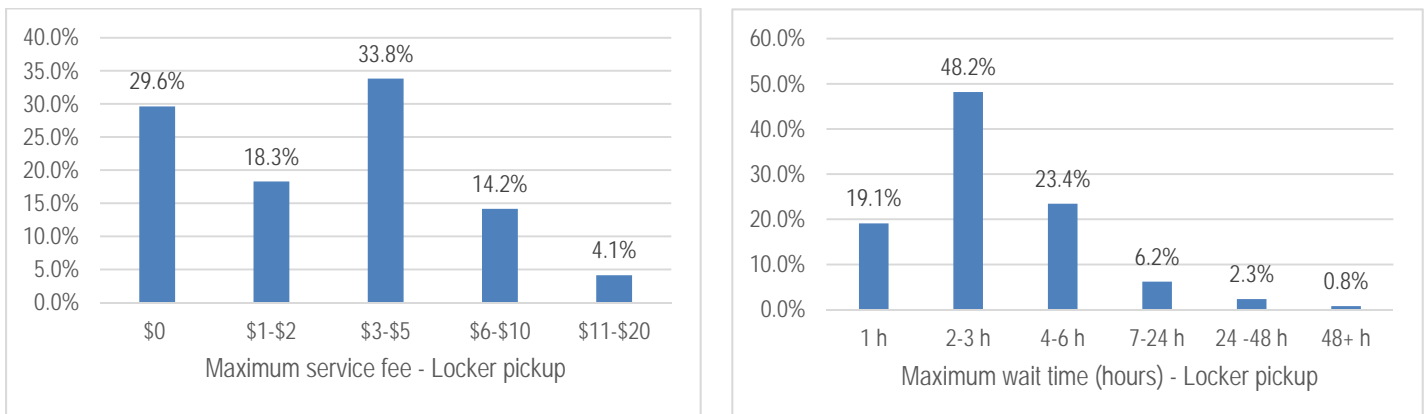


Figure 8. Maximum acceptable levels of service fee and delivery latency for locker pickup for grocery/CPG eCommerce orders.

Market potential for eCommerce

Our survey found a fair amount of optimism about eCommerce in the sense that shoppers indicated a willingness to increase their spending on eCommerce if the right type of system was available. Table 6 details the percentages of shoppers who will increasing their spending, stay the same, or decrease their spending.

Table 6.
Shopper optimism regarding eCommerce

Program	Service fee	Will increase spending	Spending will remain the same	Will decrease spending
Van delivery	\$5	51%	32%	17%
In-vehicle pickup	\$5	42%	36%	22%
In-store pickup	\$5	46%	35%	19%
Locker	\$5	32%	37%	31%

Our survey suggests that home delivery at \$5 is fairly attractive, with 51% of shoppers indicating they would increase their expenditure. In-vehicle pickup and in-store pickup at a \$5 service fee are the next-most attractive, with a little more than 40% shoppers indicating an increase in spending. The locker option seems to be the least attractive, with an equal number (approximately one-third) of respondents saying they would increase spending as those saying they would decrease spending. This is probably reflective of the limited appeal of lockers. Overall, approximately 20% of shoppers indicated they would decrease spending if the service was offered at a \$5 fee, suggesting that there is some resistance toward paying for these services. This is also to be expected.

Shopper preferences

Our survey found that for both brick and mortar shoppers and eCommerce shoppers, convenience is the most important factor (Figure 9). Employee interaction and exposure to new items are among the least important factors that concern shoppers, indicating that traditional hurdles to shoppers' adopting eCommerce are being overcome. Still, brick and mortar stores retain the advantage that shoppers value the ability to physically inspect items. A variety of products is also important in eCommerce, suggesting that eRetailers cannot afford to skimp on variety, even though it is tempting to do so to reduce costs.

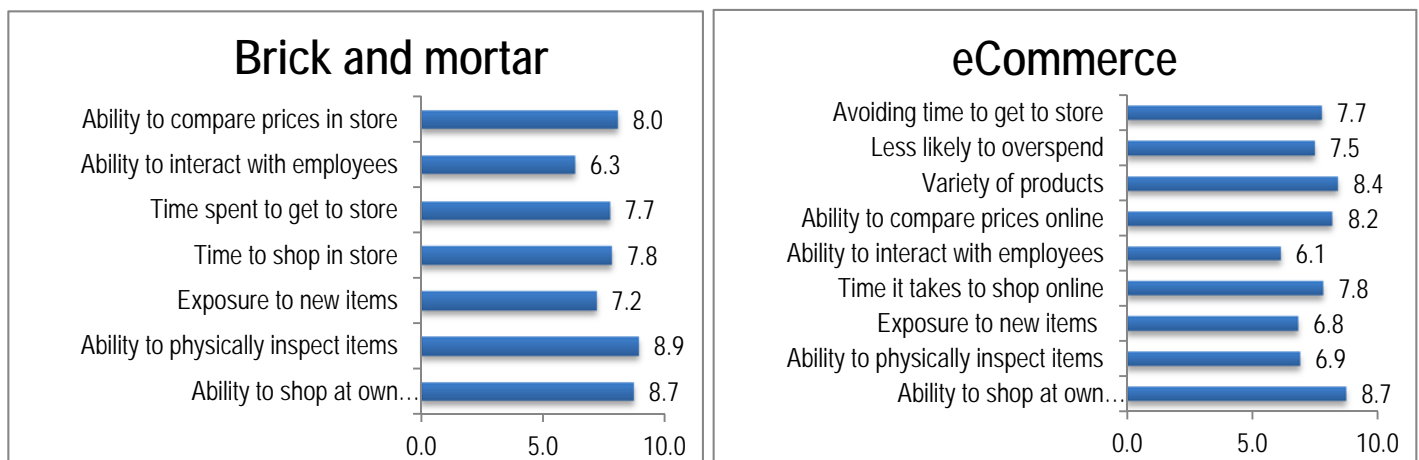


Figure 9.
Shopper preferences, grocery/CPG

Future state: Cost projections as volumes grow

The detailed Micro ABC cost model developed above allows us to project future costs as volumes increase. We begin with a straightforward projection in which the fixed costs simply amortize over higher weekly volumes, and variable costs do not change.

As Figure 10 shows, increasing volume has the potential to reduce costs significantly. For example, consider the van delivery from the store model. At current volumes of approximately 250 orders per week per store, the unit cost is approximately \$1.18. If volumes double to 500 per week (equating to about four orders per hour), the unit fulfillment cost would drop to around \$1.04. At a unit retail price of \$3.25 and using the P&L statement in Table 2, this increases unit profit from \$-0.01 to \$0.13. In percentage terms this is from -0.2% to 4.0%.

Similar reductions in cost are seen for many of the other popular fulfillment models. For in-vehicle pickup, for example, doubling the volume reduces unit cost from \$0.86 to \$0.71; using the numbers in Table 2, this would increase the true profit from \$0.20 to \$0.35 or from 6.1% to 10.8%.

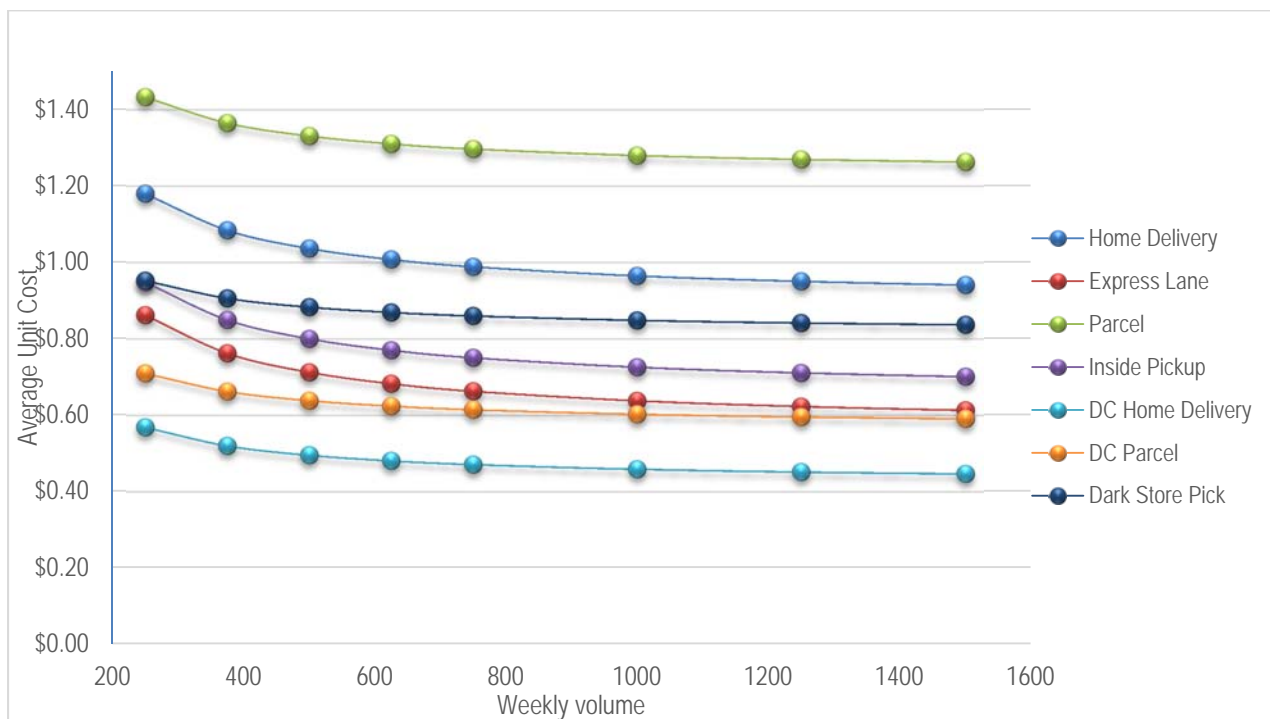


Figure 10: Average unit cost as weekly volume increases.

Therefore, we expect that over the next five years, growth in volume alone will provide some increase in the profitability of these systems. This may not be enough, however, to turn the entire eCommerce operation into the black, because the high-level indirect costs are not included in the calculations used in Table 2. The analysis that follows enhances our projections by investigating other means by which eCommerce retailers could increase their profitability.

Our work with retail partners suggests that as volumes increase, ABC costs will see marginal reductions out of improved efficiency. For example, for in-store shopping models at current volumes, labor is somewhat underused when it comes to picking orders from shelves, because typically only a single order is picked at a time. With an increase in volume, it is conceivable that multiple orders can be picked at the same time, reducing the ABC cost for

the shopping phase. Similarly, for van delivery, higher volumes would imply a denser delivery schedule and shorter distances between successive deliveries. This, too, would reduce delivery costs.

We extend our analysis by incorporating these projected cost reductions. We first consider a 1% year-on-year cost reduction rate, which we believe is somewhat conservative. Along with this 1% year-on-year cost reduction, we also assume a 15% annual growth rate in volume, which is approximately the rate at which eCommerce across all sectors is growing.

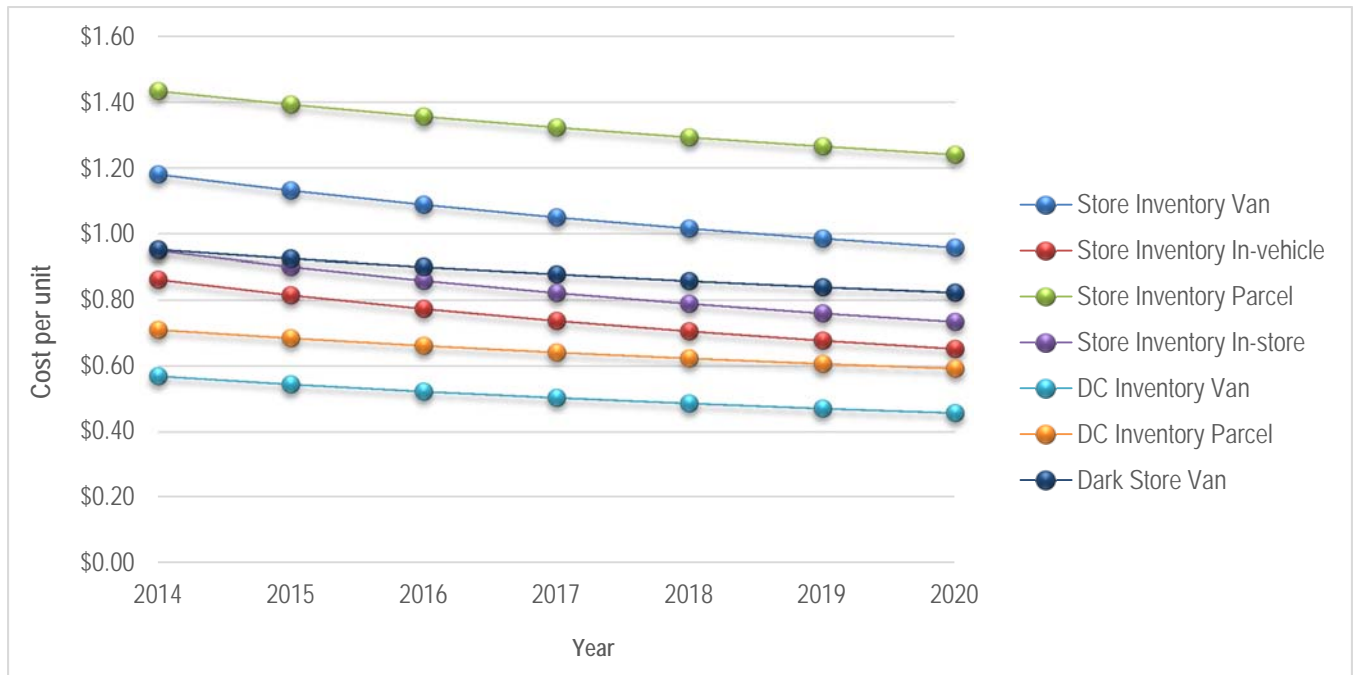


Figure 11: Projected unit eCommerce costs (for grocery/CPG orders) assuming 15% growth rate and 1% annual cost reductions

If eCommerce grows at a 15% annual rate, then from a 3% share of total grocery/CPG retail, eCommerce will account for a 5.6% share in 2020, assuming the sector as a whole grows at 4%. Figure 11 shows projected costs for each system under that scenario. To consider two of the popular models, we project that in 2020, the unit costs for van delivery from store and in-vehicle pickup will be \$0.96 and \$0.65 per unit respectively, representing decreases of 19% and 24% from their 2014 levels.

An even more aggressive scenario has eCommerce growing at 25% and annual costs reducing at a 2% rate. At a 25% annual growth rate, eCommerce would account for 9.4% of total retail in 2020. The cost reductions under this scenario are shown in Figure 12. Under this scenario, 2020 costs for van delivery from store and in-vehicle pickup are \$0.86 and \$0.57 per unit, respectively.

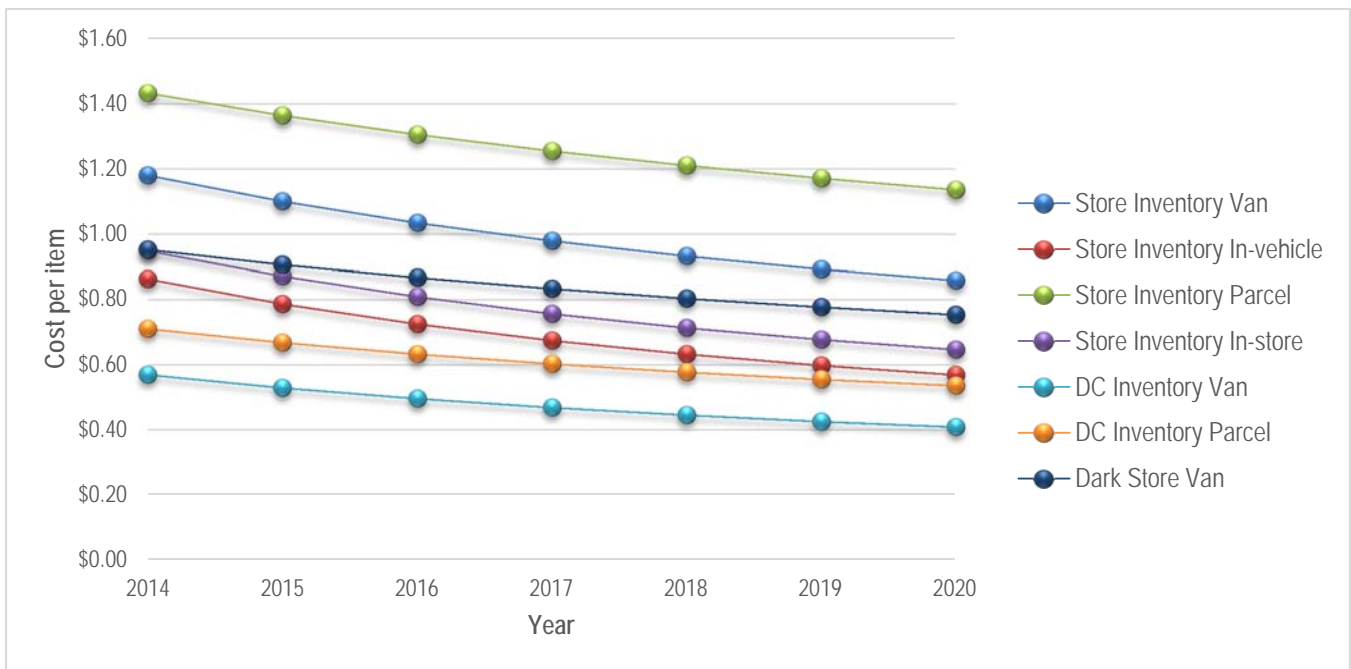


Figure 12: Projected unit eCommerce costs (for grocery/CPG orders) assuming 25% growth rate and 2% annual cost reductions

Test cases and supply chain innovations

As part of the present research, we also constructed a detailed computer simulation model of the entire eCommerce process for some of the delivery models. In these simulation models, we generate streams of orders for different items using demand distribution information from the ABC cost model. Each order in this stream of orders is a different size and consists of different items. The simulation then mimics the entire order fulfillment process for the delivery model being tested, adding up all the costs along the way. The cost for each order is recorded, and averaged over the entire stream of orders. These averages are then used to study the system's performance.

Because the computer simulation model mimics every activity in detail, it allows us to test the effect of modifying some of those activities. This, in turn, provides us with a test bed to understand the cost and service-level implications of changing the structure of some of these eCommerce delivery models. We provide the results of three such test cases/supply chain innovations in the following paragraphs. Note that these are only results from the computer simulation and not from an actual field test. Given the level of detailed information, however, from the micro ABC model that we use in our simulations, and extensive testing, we are confident that these provide reasonable projections for the cases tested.

Test case 1: Van delivery with store pick, moving some inventory to wareroom

It is well-known that the distribution of volume by SKU is very asymmetric; that is, a small number of SKUs have a very high volume, whereas a large number of SKUs have a very low volume. Another observation from our micro ABC cost model is that the unit cost for picking a single item for an order is significantly different depending on whether inventory is picked from a store or from a DC, for obvious reasons. Specifically, picking from store shelves costs \$0.26 per unit, but picking from a DC shelf costs \$0.035 per unit.

This suggests the value of an idea that has been circulating in the industry: the concept of a wareroom. Suppose the retailer moves the top say 10% of SKUs to a separate inventory room, where shoppers are not allowed. This wareroom is specially designed for fast picking of eCommerce orders. When an eCommerce order arrives, SKUs that are available in the wareroom are filled quickly and cheaply from there, after which the worker picks the remaining items from store shelves.

Using our computer simulation model and precise data from the ABC model that provides the distribution of SKU volumes, we can estimate the costs of implementing a wareroom by moving various percentages of the inventory to the wareroom.

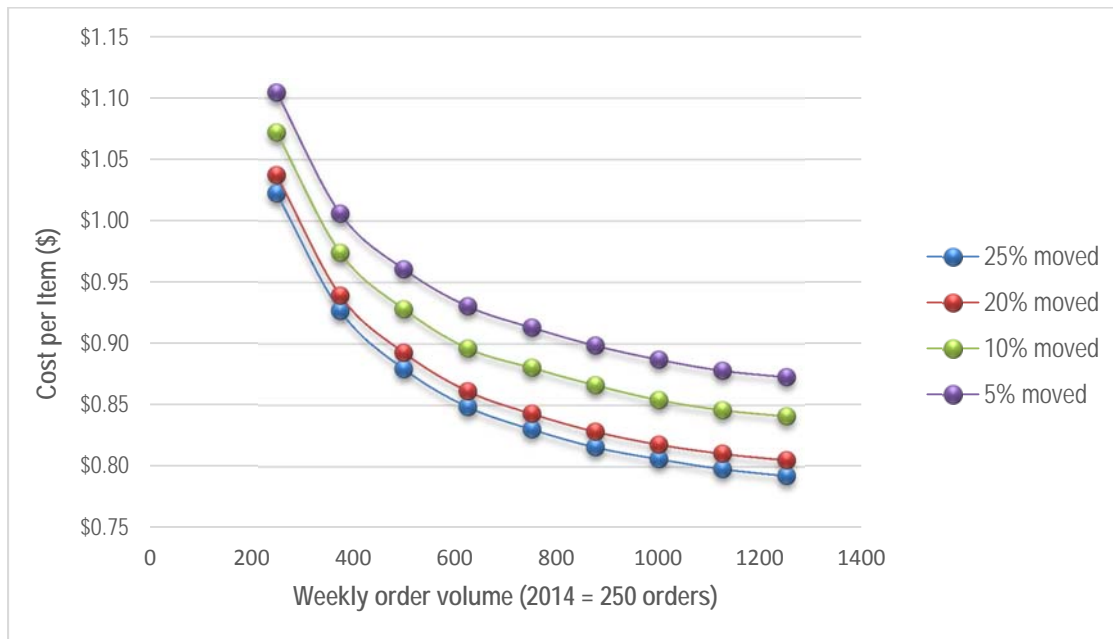


Figure 13: Estimated unit cost for van delivery from store model.

As Figure 13 shows, even at current volumes (250 orders per week on average for 2014), moving 5% of the top-moving SKUs to the wareroom results in a unit cost of \$1.10, compared to the \$1.18 reported in Table 2. If the top 20% of SKUs are moved (at 2014 volumes), unit cost decreases to \$1.04, representing a 4.3% improvement in profit. If we combine moving 20% of the top SKUs with a doubling in volume (at a 15% growth rate, volume is expected to double by 2019), the unit cost of fulfillment decreases to \$0.89. This represents a \$0.29 improvement compared to the baseline from Table 2 and thus changes the true margin from -0.2% to 8.6%. Note that the true margin would have improved to 4.0% with the volume increase alone (Figure 10); as such, the wareroom provides an additional 4.6% improvement in profit.

Note that this is only an approximation. True picking costs from a wareroom may be slightly more or slightly less than picking costs from a DC depending on the equipment. In addition, our analysis does not include the cost of installing the equipment. However, our analysis provides evidence of the potential to reduce costs by deploying warerooms.

Test case 2: Using larger vehicles for van delivery from stores

As reported in Table 2, van delivery is much less expensive when it originates from a DC (unit cost \$0.57) than when it originates from a store (unit cost: \$1.18). One of the drivers of this cost difference is the average delivery cost, which is cheaper from DCs (\$0.23 vs. \$0.32). This is because DC delivery models use much larger vehicles, which are able to do 10 or more deliveries per trip when fully loaded. In contrast, store delivery models use smaller vans, which on average only four deliveries per trip when fully loaded. So, even though deliveries from DCs typically require longer routes, the cost efficiency gained by doing multiple deliveries in a single trip is significant.

As eCommerce volumes grow, this naturally suggests that store delivery models should also consider using the same larger vehicles that are used in DC delivery models. We investigate the cost effect of this, using our macro simulation model.

Figure 14 illustrates the cost reductions if large vehicles are used for van delivery from a store. The baseline is the “small vehicle, 0% SKUs in wareroom” curve. At current volumes of 250 per week, we see that the unit cost is \$1.18 as reported in the P&L chart (Table 2). If a large vehicle is deployed (but a wareroom is not deployed), the unit cost drops to approximately \$1.08. If volume is doubled to 500 orders per week, the unit cost reduces further, to approximately \$0.93. If in addition a wareroom is deployed and 20% of the SKUs are moved to the wareroom, unit cost declines even more, to \$0.79 per unit. At this level, assuming a retail price of \$3.25 per item purchased, van delivery from a store becomes relatively profitable, yielding a true margin of 11.7%.

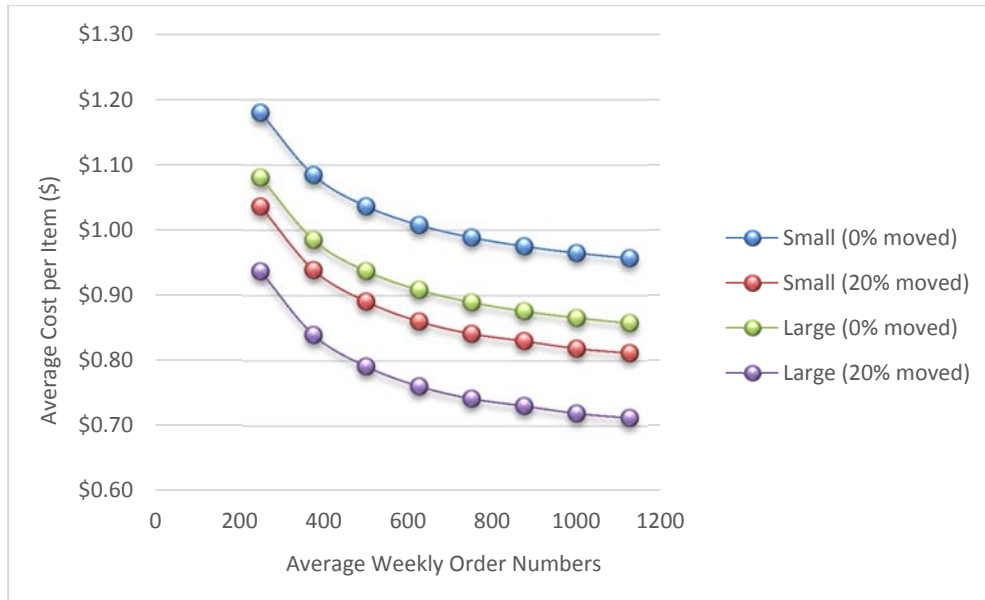


Figure 14. Unit cost for van delivery from store for eCommerce grocery/CPG orders, changing vehicle type and wareroom deployment.

Test case 3: Store inventory with in-vehicle pickup: The effect of number of servers

Lastly, we use our simulation model to shed some light on the interaction between fulfillment cost and customer service. Specifically, we consider the in-vehicle pickup model. This model is subject to severe peaks in the pickup time, with the most popular pickup time being when shoppers are returning home from work in the evenings. Shoppers who arrive for pickup and find a line are not likely to be satisfied, particularly if they have to wait too long. In fact, to tie this back to our survey, Figure 6 shows that 80% of shoppers consider a wait of 10 minutes to be acceptable but would not be willing to wait longer than that.

Our eCommerce models do not assume any specific physical design of the in-vehicle pickup system. But, there are many possibilities. One is a drive-through lane, such as at fast-food or prescription pickup windows. These typically can serve only one shopper at a time, with others queuing up behind. Another possibility is to reserve a small number of parking spaces close to the main entrance for in-vehicle pickups. At current volumes, these systems are unlikely to see much of a vehicle queue; instead, the queue is internal to the retailer. The retailer can then choose to deploy additional labor to clear the queue, much as it would if the queue at the checkout line becomes too long.

Figure 15 shows the cost curves and average wait time for our computer simulation of the in-vehicle pickup model, in which we vary the number of servers.⁸ Here, server is a general concept that represents the number of in-vehicle orders that could be fulfilled simultaneously if given the appropriate level of human capital. At a very minimum, having say three servers means that there are three workers simultaneously filling orders, along with space for three

vehicles to be parked—whether in the parking lot or in the drive-up lane. Note, too, that these numbers assume that 20% of the top SKUs have been moved to the wareroom. Even if there is no wareroom, however, our findings are the same in terms of overall trends.

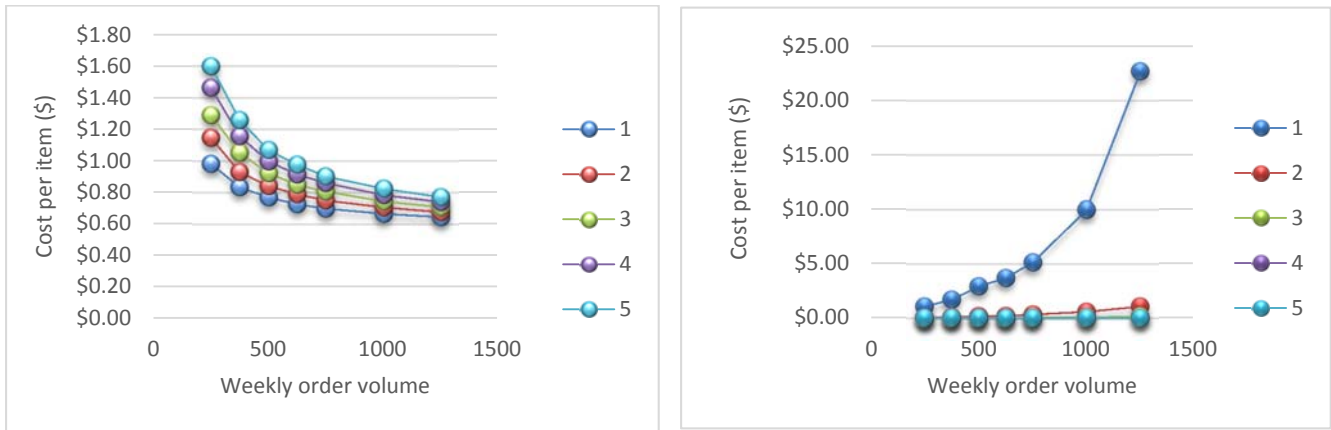


Figure 15.
Unit cost and wait time for in-vehicle pickup of eCommerce grocery/CPG orders, as number of servers varies

The main finding confirms that limiting responsibility to a single server is very dangerous and quickly increases the average wait time if volume increases. Adding just one more server reduces wait times dramatically, even with a large growth in volume. This suggests that as retailers configure their in-vehicle pickup systems, they must allow for serving at least two shoppers simultaneously—by having flexible labor policies and by having a physical design that permits two cars to be stationed at places where they can both be served.

Conclusion and Recommendations

Our three-pronged study of eCommerce distribution systems in the grocery/CPG sector has revealed several useful insights:

1. As currently structured, all eCommerce systems in the grocery/CPG sector are barely profitable when only direct going costs are taken into account. If indirect startup costs are also included, these systems operate at a *loss*. In general, the three largest cost drivers are delivery expenses, store/warehouse picking labor, and occupancy.
2. *In-vehicle pickup at the store* and *van delivery from a DC* in high-density markets are the most cost-efficient delivery systems the present study found. If the shopper pays shipping costs, parcel delivery from the DC is also cost efficient. Minimizing touches in the supply chain, increasing order size, and increasing the number of deliveries per van route are all key enablers to improving cost efficiency.
3. Shoppers see value and are willing to pay for the convenience of these services. A majority of shoppers consider \$6 to \$10 a reasonable fee for delivery to their homes, and \$3 to \$5 for in-vehicle or in-store pickups. However, shoppers expect their products relatively soon (within six hours or less), with very few willing to wait until the next day.
4. There is tremendous market potential for eCommerce in the grocery/CPG sector, with shoppers willing to significantly increase their spending in this channel if the right kind and right priced distribution systems are available. At a \$5 fee, approximately 80% of shoppers state they will either increase or maintain their current level of grocery/CPG shopping they do via eCommerce.

5. As projected volumes increase and operations become more efficient, there is an increased opportunity for profitability in the distribution systems. We project that at a 15% annual growth rate in volume and 1% annual cost reduction rate, unit profit margins of eCommerce models in grocery/CPG can reach into the 12% to 15% range.
6. Some supply chain innovations, such as moving fast-moving items to a wareroom if store fulfillment is used, or using larger vehicles to complete more deliveries per trip, offer greater opportunities for cost savings. For example, combining both the wareroom with larger vehicles and assuming a doubling in volume over 5 years, the van delivery from the store model advances from being marginally unprofitable to a profit margin of approximately 11% to 15%.

¹ Quarterly US ECommerce Sales, 3rd quarter 2014, US Department of Commerce. See http://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf

² According to the US Department of Agriculture, 2011 total retail food and nonfood sales was \$571 billion. At a 4% annual growth rate, projected sales for 2014 are \$640 billion. See <http://www.ers.usda.gov/topics/food-markets-prices/retailing-wholesaling/retail-trends.aspx>

³ <http://www.washingtonpost.com/blogs/federal-eye/wp/2014/09/25/mail-and-milk-struggling-postal-service-wants-to-deliver-groceries/>

⁴ Numbers rounded to nearest \$0.01; may not add up due to rounding.

⁵ Complete survey details, including survey questionnaire and individual responses, are available upon request. Please contact Amitabh Sinha, amitabh@umich.edu.

⁶ In the survey instrument, we used the terminology "home delivery," In the present whitepaper, we have used "van delivery" to make the terminology consistent across the document.

⁷ Both Walmart and Amazon are experimenting with lockers, as are some other retailers. See http://bits.blogs.nytimes.com/2013/03/27/wal-mart-introduces-lockers-as-it-battles-amazon-in-e-commerce/?_r=0.

⁸ Some additional details regarding this point: The total time spent by a dedicated server per order is roughly 5 minutes Shoppers are given 15-minute windows for arrival, but because of traffic variability and so on, they tend to arrive late, also averaging 15 minutes.