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ELECTRONIC COMMERCE DISTRIBUTION AND FULFILLMENT IN CANADA: THE CASE OF A LARGE CANADIAN RETAILER

by

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ABSTRACT

As electronic commerce continues to become more important, an increasing number of retailers have changed their strategies for fulfilling online orders from central facilities to the "brick-and-mortar" store network. In this situation, one pertinent question is, "how does online fulfillment design affect a retailer's profits?" Big brick-and-mortar retailers overestimate the financial performance of online sales (Lee and Whang, 2001; Yrjölä, 2001; Nicholls and Watson, 2005; Rabinovich et al., 2008; Ko and Roztocki, 2009; Randall et al., 2011; White, 2016). However, the existing literature does not give any indication as to which strategic and tactical distribution, and fulfillment strategy, will yield the best performance for multi-channel retailers (Agatz et al., 2008; Zhang et al., 2010).

This thesis reviews the multi-channel retail supply chains of a major Canadian retailer by examining its fulfillment performance in both financial terms and service level. The study will focus on the retailer's expected profit and its determinants, including the capacity and efficiency of its network for online fulfillment. In examining the possibility of making fulfillment more effective, the study will substitute the decentralized fulfillment approach with the centralized fulfillment approach and substitute the current Courier Expresses Parcel (CEP) service provider with two alternatives. The ultimate objective is to recommend alternatives to the status quo to the retailer.

The results of this study are that changes in the last-mile delivery design and CEP service provider result in significant reductions in shipping costs of 140% to 430%. Changing from decentralized to centralized fulfillment does not show a significant reduction in shipping time but offers lower variance in fulfillment time thanks to automation in picking and packing. The centralized fulfillment centers (FCs) also lower shipping and handling costs using the same CEP. However, the saving of these costs is not substantial enough to offset the increase in inventory cost and facility cost given moderate demand growth rates.

Keywords: Supply chain, e-commerce, multi-channel retail, a Canadian retailer, distribution, profitability, online fulfillment center, profitability, shipping cost, ROI.

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LIST OF ABBREVIATIONS

Provinces	Atlantic: Newfoundland, Nova Scotia, Prince Edward Island, and New Brunswick AB: Alberta BC: British Columbia MB: Manitoba All Territories: Northwest Territories, Yukon Territory, and Nunavut ON: Ontario QC: Quebec SK: Saskatchewan
Logistics terms	3PL: Third-party-logistics BAM: Brick-and-mortar B2B: Business-to-business B2C: Business-to-customer CAGR: Compound annual growth rate CAM: Click-and-mortar CEP: Courier expresses parcel CFS: Contingent/conditional free shipping DC: Distribution Center FC: Fulfillment Center LSPs: Logistics service providers NPV: Net Present Value ROI: Return on investment SC: Shipping cost SFS: Ship from store SKU: Stock Keeping Units SQ. FT.: Square feet TL or LTL: Truckload or less-than-truck-load

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I. INTRODUCTION

There is an emerging trend among brick-and-mortar (BAM) retailers of adding online sales channels to the store network. However, it has been observed that it is difficult to achieve profitability from online sales (Barsh et al., 2000; Cleophas and Ehmke, 2014). Research shows that there is a strong relationship between supply chain problems and profitability (Osborn and Nault, 2012). In particular, distribution network design and online fulfillment capability investment are key determinants of profitability for a firm, due to their significant influence on total supply chain costs and customer experience (Chopra, 2003; Trefis Team, 2014a; HRC Advisory, 2016).

Many studies show that building an efficient supply network will ultimately increase a network's profitability (Porter, 1985; Lee and Whang, 2001; Yrjölä, 2001; Nicholls and Watson, 2005; Rabinovich et al., 2008; Ko and Roztocki, 2009; W. S. Randall et al., 2011; White, 2016). There are no existing empirical studies focusing on both fulfillment performance and profitability of BAM retailers when they convert to the click-and-mortar (CAM) model. Limited research is available on the interplay of supply and demand, costs, and revenues in online fulfillment (Agatz et al., 2008).

In reviewing the strategic resource management model, Ring et al. suggested that the gross margin of retail businesses can be enhanced by decreasing hidden costs and by managing shipping revenue to improve productivity and financial performance (Ring et al., 2002). Consequently, retailers can review their distribution and fulfillment decisions regularly to improve their network performance and optimize their fulfillment strategies (Manning et al., 1999). To that end, this study provides an empirical study of a Canadian multi-channel retailer's online fulfillment practices and its profitability. This section discusses the study's research scope, the research process and methodology, and finally, the research questions.

Order fulfillment capability has been identified as the Achilles' heel for both large, established retail giants and emerging online retailers (Mullaney, 2001). The bankruptcy of major retailers such as Webvan demonstrates the importance of distribution and fulfillment strategies (de Koster, 2003). Regarding tactical strategy, the emerging trend among industry players is to

increase customers' postal and shipping charges, increase automation in fulfilling orders, and lowers their handling and delivery costs. The Hudson's Bay Company is one Canadian retailer that sees opportunities for enhancing its gross profit through e-commerce fulfillment and distribution. By investing hundreds of millions of dollars in distribution centers (DCs) for online channels, HBC has aimed to optimize inventory productivity across each and every banner under its product portfolio (HBC, 2016).

The company explored in this study (from here on referred as "The Company") is also struggling to optimize its online order fulfillment capability. Like many other Canadian omnichannel retailers, The Company faces a shipping cost management issue. It has not been able to calculate the total cost of serving orders across Canada. Its network of stores across the country and millions of SKUs are profitable, but its serving cost for online orders causes losses due to expensive transportation services for online fulfillment.

This study reviews the distribution and online fulfillment operations of The Company to find the most optimal solution for a company that does not have separate business performance tracking for its online and traditional channels. It is a challenge to understand and define a distinct set of online fulfillment problems. In attempting to calculate online fulfillment costs and present alternative fulfillment options, this study aims at recommending a more efficient delivery fulfillment network for its growing e-commerce channel. Specifically, the optimal number of fulfillment centers, their locations, and their sizes are proposed. Finally, the study aims to realign supply chain operations with financial objectives and business objectives.

A. Research scope

This study's objective is to understand the major problems in order to solve them and to achieve operational efficiency and financial sustainability in fulfilling online. Existing multi-channel retail research has not contributed to a new understanding of the financial sustainability and operational efficiencies for online fulfillment strategies and has not provided a dynamic approach to the complex problem of operations for emerging retailing trends. This study provides practical implications that are relevant to operations management for practitioners in this field.

In reality, online sales fulfillment is highly complex and comprises multiple processes that are interrelated and inseparable. The relationships and interactions among these variables are more prominent than others. This study aims at finding these interdependencies. The study examines and analyzes the strategic areas of operations and planning management and proposes methods to achieve online fulfillment strategies which are efficient, profitable and sustainable. Due to time limitations, the study leaves out the other sales channels and remains focused on the online channel only.

B. Research process and methodology

This study uses the explorative study method which applies for embarking into the unknown areas of logistics (Karlsson, 2009). While the mentioned study method is relevant, the action research approach is uniquely built to explore a business case that undertakes changes. By collaborating with practitioners, the researcher aims at understanding the process, identifying the operational problems, and finally proposing necessary modifications to the operations (Karlsson, 2009). Analytical tools such as the application of profit calculation and discounted cash flow are used to find the optimal ROI for The Company.

As the transaction data in the study period is not a complete 12-month period, the researcher assumes that mean values of relevant variables used in the panel data for the analysis still represent the company's order profiles. This assumption is based on the use of inferential statistics to draw inferences about the mean based on the sample data of online sales during three months. After all calculations, had been completed, data presented in this study were changed to ensure confidentiality. Despite these changes, the calculation results still reflect the depth and complexity of The Company's cost, revenue, and profit structure. In presenting revised data, percentages and ratios, the study makes efforts not to reveal business information. The study makes every effort not to change the nature and significance of the supply chains problems faced by the retailer.

As there is limited research in this area in Canada and in other countries, this study explores emerging trends in online fulfillment, such as the use of third-party logistics (3PL) for parcel shipment from the store. The study aims to provide applicable managerial recommendations based on a comprehensive operational examination of the retailer's online fulfillment capability. The

analyses of capacity and service design is an interconnected process where one analysis links to the other. Our objective in finding alternatives to existing online fulfillment center designs and shipping services is not to find the optimum solutions mathematically. Rather, this study evaluates the options to find the balance between the resources and the constraints facing The Company in particular. The solutions thus need to be realistic and feasible to be evaluated under the scope and the data available to the researcher. Since the researcher has signed a confidentiality agreement to keep the retailer's name undisclosed and their business information confidential, the business data in the report is very carefully chosen. However, this constraint does not prevent the study from reflecting the reality of the company's supply chains problems.

Two main phases characterize this research: 1) the pre-interaction section, to identify the relevant issues in the context of the multi-channel retailing environment; 2) the collection and analysis of available data and information for optimal solutions for the fulfillment problems defined in the first phase. Firstly, this project reviews the existing literature and selects the methodology to answer the research questions. This step is important as it can provide an overview of the research problem by mapping out the explored and unexplored areas of knowledge. For this section, a general view of all areas directly and indirectly related to the distribution system (i.e. network design, facility location, online retailing operations and online fulfillment) is adopted. This so-called "funnel process" allows flexibility to navigate the various pertinent problems in defining precise angles of the research.

Secondly, once the existing literature is examined, the researcher embarks on collecting and exploring the relevant data. The primary goals for this data collection are: 1) to understand the company's business; 2) to get a broad understanding of the operational problems, their components, and root causes, and the constraints in solving these problems; 3) to understand the company's current and future business plans to address the relevant operational challenges in the medium- and long-term horizon; 4) to collect the relevant operations data; and 5) to identify the chief problems in the various processes and analyse the potential options. These steps are also designed to identify the weak links in the online fulfillment process and to align The Company's operational objectives to its financial objectives.

C. Research questions

This research reveals the interactions between the choices of a Courier Expresses Parcel (CEP) service provider, method of passing along shipping charges to the customer, fulfillment center (FC) options, and profitability. The research questions are specifically established after these interactions. The information pertinent to the research questions is systematically mapped out. Based on that, the study assesses the retailer's capabilities throughout The Company's supply chains and maps out the key components that determine costs and profit margins.

For a retailer that does not own in-house fulfillment capabilities, it is observed that financial performance and service level are impacted mainly by two factors provider (The Company, 2016): 1) the FC network design and 2) the partnership with CEP service (Figure 1). First of all, this study attempts to answer the question related to its online fulfillment center and distribution network design. Secondly, the study aims to explore the delivery service design comprising the choice of CEP service provider, the shipping costs, and the retailer's shipping charges to shoppers. These two factors may be combined to answer three research questions related to The Company's financial performance and service performance.

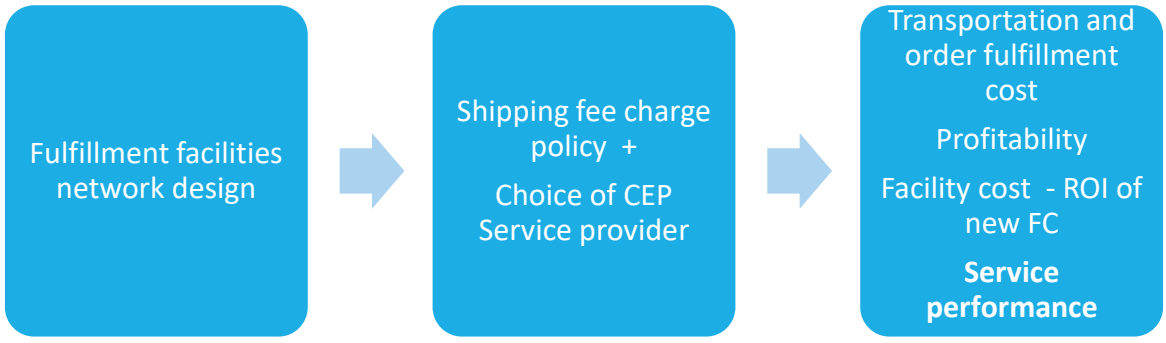

Figure 1: The interplay between CEP service design, fulfillment center design, and performance

Research question 1: How do the current delivery service charges influence the shoppers' order value?

Research question 2: How do various 3PL suppliers' shipping costs impact online fulfillment profitability?

Research question 3: What are the various distribution network options for more profitable online sales fulfillment and better return on investment (ROI)?

II. LITERATURE REVIEW

Electronic commerce, or e-commerce, is a process innovation in which the Internet and communication technology provide a platform for the reconfiguration of existing business and sales channels (Burt and Sparks, 2003). E-commerce has had a profound impact on the traditional supply chains activities, namely procurement, inventory control, and logistics (Soloner and Spence, 2002).

Boyer et al. (2002) suggest that the evolving e-commerce era offers businesses the opportunity to re-design their product and service development strategies and their supply network. Wider varieties of products and services can be provided at a lower cost in a more comprehensive geographic coverage, bringing down the costs of inventory, facilities, and labor, but not those of transporting products. In terms of supply networks, thanks to the variety of channels, more delivery options are available (Boyer et al., 2002; Hill et al., 2002)

In the past, retailers conducted their operational and distribution activities from the store. Hence, the large part of their last-mile delivery process happened at the store and with direct customer contact, except for catalog retailers who mailed orders to customers. The current trend of converting store networks to multi-channel retail networks requires an entirely different approach to last-mile delivery. For traditional retailers who add an online channel to their businesses, the new customer base demands a new product delivery model and distribution network design (Tarn et al., 2003). The existing literature on multi-channel fulfillment management mainly focuses on the operational aspects that have an impact on the service quality level and on the positive growth brought by e-commerce. Most of the existing research carries an overoptimistic view of the contribution of this new channel to business and underestimates the roles of freight transport, logistics and physical distribution (Hesse, 2002). There is limited research on the realistic impacts of distribution and fulfillment strategies on business performance.

The literature review has five parts: Part A briefly discusses the general landscape of online retailing in Canada. Part B studies the operations of online retailing. Part C studies multi-channel retail operations in greater detail, focusing on impacts on the supply chain. Part D reviews the substantial hurdles that a traditional retailer faces in adding online business. Part E explores the

changes in retail supply chains in the e-commerce context. Part F discusses distribution networks and online fulfillment processes, focusing on fundamental concepts and components. Part G examines supply chains planning at the tactical level for delivering online orders, and the quantitative research related to shipping fee schedule and profitability.

A. Online retailing in Canada

1. ONLINE RETAIL MARKET IN CANADA

The online retail market in Canada continues to grow strongly. Figure 2 shows this upward trend in recent years and projected years (2015-2019). Data from 2012-2014 shows a compound annual growth rate (CAGR) of 17.6% while the forecast promises 18% in the period of 2012-2019. In 2014, Canada's e-commerce sales reached 25.37 billion $CA. In a Forrester survey, one-third of 131 Canadian retailers revealed that their gross online sales in 2014 increased more than 25% relative to 2013 while another quarter reported an increase between 10% and 25% (Forrester, 2015).

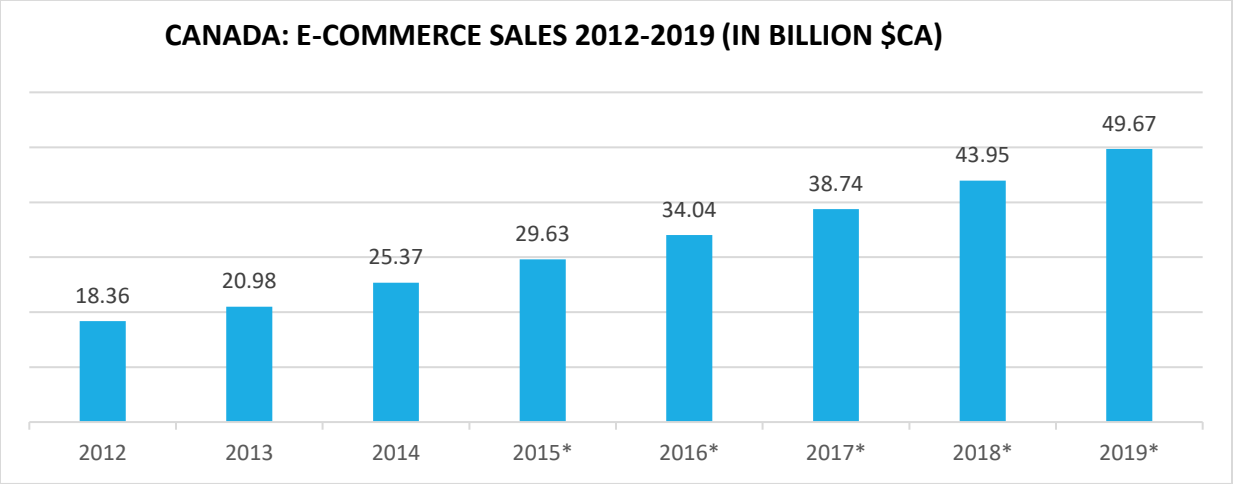

Figure 2: Canadian e-commerce sales 2012-2019 (eMarketer, 2016)

* E-commerce sales in these years are forecasted value

Apparel is the second largest-selling product category after media products. In Canada, the online sales growth rate for apparel is 19% annually, while some retailers saw even higher growth rates (Euromonitor, 2015). The market share consolidation among apparel retailers in Canada is not very high, as is demonstrated in Table 1. The four largest companies in Canada are TJX

Companies, Reitman Group, Canadian Tire, and Gap, with a combined share of less than 20% of market sales in 2011 (Industry Canada, 2013).

Retail Sub-Sectors	2011 Sales (millions)	Market Concentration Ratios (percent)	Top Four Retailers in each sub-sector
Furniture and Home Furnishing	$15,028	35.2%	1. Sears (10.7%); 2. The Brick (10.2%); 3. IKEA (8.5%); 4. Leon's (5.9%)
Electronics and Appliances	$14,982	55.2%	1. Best Buy (40.2%); 2. Apple (4.7%); 3. BCE (3.7%); 4. GameStop (3.6%)
Home Improvement	$27,037	74.6%	1. Rona (23.9%); 2. Home Depot (23.8%); 3. Home Hardware (17.6%); 4. Tim-Br Marts (9.4%)
Grocery/Food	$104,134	61.9%	1. Weston Group (30.0%); 2. Empire Company (15.1%); 3. Metro (10.4%); 4. Safeway (6.4%)
Pharmacy and Personal Care	$32,848	68.6%	1. Shoppers Drug Mart (31.8%); 2. Katz Group (16.7%); 3. Jean Coutu (12.2%); 4. McKesson (7.9%)
Clothing and Accessory	$26,049	18.9%	1. TJX Companies (7.7%); 2. Reitman Group (3.9%); 3. Canadian Tire (3.8); 4. Gap (3.5%)
Hobby Store	$11,155	35.0%	1. Canadian Tire (15.1%); 2. Indigo Books (8.3%); 3. Toys 'R' Us (7.2%); 4. Golf Town (4.4%)
General Merchandise	$56,770	85.7%	1. Wal-Mart (41.5%); 2. Costco (24.4%); 3. Canadian Tire (10.2%); 4. NRDC (9.6%)
Miscellaneous	$10,696	34.8%	1. Staples (28.4%); 2. Petsmart (2.9%); 3. Roark Capital (2.3%); 4. Hallmark Cards (1.2%)

Table 1: Market concentration in Canada by retail sector (Industry Canada, 2013)

Retailers from the United States are omnipresent in the Canadian retail market. The top 10 retailers from the US capture more than 90% of the market share of all non-Canadian retailers (Industry Canada, 2013). This dominance is explained by various factors, including the proximity of the two countries, a shared language, and the common behaviors of the consumers (Industry Canada, 2013). Furthermore, retailers from the US can take advantage of their existing supply chains networks to lower investment costs and reduce operational risks. Recently, new international retailers are taking the spotlight by increasing their interest and presence in Canada. IKEA was the largest non-US based retailer in Canada in 2011, with retail sales of $1.3 billion. Japan's 7-Eleven, Sweden's H and M, and the UK's HMV were the next top players in retail sales in 2011 (Industry Canada, 2013).

Most foreign retailers in Canada favor major cities such as Calgary, Edmonton, Montreal, Toronto and Vancouver. As a result, Canadian consumers outside these metropolitan regions do

not fully benefit from the penetration of these companies except for merchandise stores such as Wal-Mart and Costco (Industry Canada, 2013).

Table 2 shows some top concerns of Canadian online shoppers. According to a consumer survey by Forrester, nearly 70% of over 1,100 shoppers think that delivery costs are too high while 56% of them find that making a return is too difficult (Forrester, 2013). The survey by Forrester also indicates that when a retailer sets a free shipping threshold, such as $50 per order, 56% of the respondents will order additional items to qualify for that offer (Forrester, 2013).

	"Which of the following, if any, are concerns you have about shopping online?"	**"My concern has heightened in the past 12 months."**
Delivery costs are too high	68%	36%
Making a return is too difficult	56%	25%
Price is no longer competitive after Canadian taxes have been added	39%	39%
I can buy the same products for cheaper on a US site (even when factoring in shipping, customs duties, and taxes)	37%	31%
I cannot find the products(s) I want for sale online in Canada	37%	27%
I don't want to give out my personal financial information (debit/credit card number) on the Internet	31%	37%
I am concerned that I may not be at home when the products are delivered and missing the delivery is inconvenient for me	31%	23%
Shipping takes too long	29%	20%
The retailer I want to buy from does not have a Canadian online store	27%	30%
I am unsure if the pricing is in Canadian dollars or US dollars	23%	19%
I want to be able to sample products before I buy them	22%	18%
I don't trust that products will be delivered in good condition	18%	17%
The site is not localized for my native language	12%	25%
I don't have any concerns about shopping online	6%	

Table 2: Top concerns of Canadian online shoppers (Forrester, 2013)

According to a survey of 108 Canadian retailers, 77 are multi-channel players with a store-based structure while only 5% are retailers who sell through the online channel only (Mulpuru, 2015). As demand continues to grow, management from a multi-channel retail perspective, operations and supply chains become more important (Snyder, 2013).

2. LOGISTICS MANAGEMENT IN CANADA

a) Increase of outsourcing to lower-cost countries

Globalization and e-commerce growth continue to present more choices for customers worldwide. This trend drives up the demand for online products and services and requires more customized and sophisticated offerings, all at lower prices. These pressures force Canadian companies in both production and service sectors to increase their outsourcing and offshoring to lower–cost countries (Industry Canada, 2008).

Benefits of outsourcing include lower costs for procurement and production, better responsiveness to production plans, less capital investment expenditures and economies of scale in outsourcing to specialised manufacturers, greater flexibility, more efficient risk pooling, and an increased focus on core competencies (Roy, 2006; Simchi-Levi et al., 2008; Parker, 2013). The downside of outsourcing and offshoring includes longer cycle times due to the extension of the chain to an overseas country, and the increase of supply chains risks such as congestion at ports, capacity problems from foreign suppliers, or quality problems (Roy, 2006).

This trend amongst Canadian companies creates a need for expedited transportation, more capacity to carry inventory locally to compensate for the added replenishment time, and more complex local distribution facilities to consolidate shipments received from outside Canada (Industry Canada, 2008). The global sourcing trend leads to the establishment of new DCs and the expansion of existing facilities in Canada (Roy, 2006). Investment in distribution facilities in Canada in the period of 2001 to 2007 increased by 61% from $513 million (Industry Canada, 2008).

Figure 3 shows the disproportion between the concentration of population and investment in distribution facilities. According to Industry Canada, in 2010, one-third of distribution facility investment flowed to Ontario. The growth of distribution facility investment is not uniform from province to province; there has been significant but lesser investment in Alberta (25%), Quebec (12%) and British Columbia (10 %). From 2005 to 2010, distribution facility investment in Alberta grew primarily among companies which serve Western Canada and Northern U.S. markets (187%). The growth of distribution hubs in Ontario (123%) and Québec (83%) were driven by

demand in the east coast and the continental regions. In British Columbia, the growth of 79% was the result of deconsolidation demand from the Vancouver area's sea port. The growth was modest in Manitoba, Saskatchewan and the Atlantic provinces (40%) (Industry Canada, 2008).

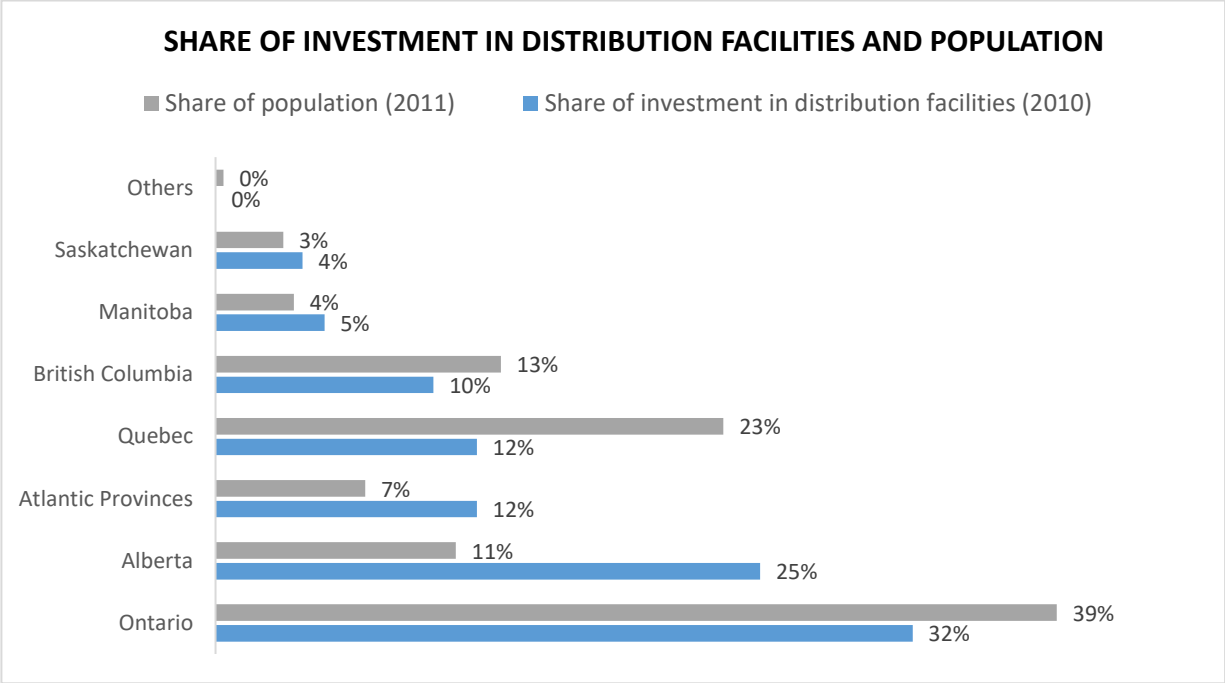

Figure 3: Share of investment in distribution facilities versus population density (Industry Canada, 2008; Statistics Canada, 2015)

b) Upward logistics and supply chain management cost

From 2005 to 2007, total logistics and supply chain management (SCM) costs went up by 3% for the whole economy, with the largest increase affecting the retail sector (22%). Both manufacturers and wholesalers control the growth within the 1% (Industry Canada, 2008). The rise in SCM cost for retailers is linked to the increase in inventory carrying costs. Inventory carrying costs include costs of holding inventory, shrinkage costs, obsolescence costs of inbound goods and finished goods, and channel obsolescence cost (Canada and Supply Chain Logistics Association Canada Research Committee, 2006; Parker, 2013). The outsourcing of production has led to a 35% accumulation of inventory levels and a proportionate increase in its carrying cost.

c) Higher cost of retailing in Canada

Canada's land area of 9,093,507 square km is home to only 35.1 million people (Economist Intelligence Unit, 2014). This geographic distribution explains the difficulties which retailers face in maintaining extremely long supply lines; prices are driven up by the high costs of transportation and logistics across the country. Delivering to hundreds of locations across Canada can represent a high-cost component that reduces a firm's profit margin. According to the Canada Retail Council, distribution and transportation costs account for at least 3.5% to 4.5% of sales values for Canadian retailers (RCC and IBM, 2004).

The disadvantages of Canadian supply chains are well demonstrated by the operational performance of retailers who operate in both the US and Canada. Consider the case of the Target Corporation, which failed in its efforts to create a Canadian subsidiary in part due to its distribution network design (Marc, 2014). Target's supply chains infrastructure in Canada served a much less dense network, with the furthest store being 1,644 miles away from its DCs. Marc suggests that the density of its distribution network explained its expensive logistics and SCM. Despite the fact that Canadian customers have changed their shopping behavior dramatically, delivery costs and pricing remain top concerns about shopping online. Forrester reports that most shoppers do not like high transportation costs (Forrester, 2013). Canadian shoppers generally prefer online shopping with e-commerce sites from the US because of better prices, wider choices and free shipping (Mulpuru, 2015).

The previously mentioned Forrester survey (Forrester, 2013) on customer preference suggests that in response to Canadian shoppers' preferences, online retailers increasingly use free shipping promotions to increase order sizes. For example, while Lululemon does not charge a shipping fee, other Canadian retailers such as The Bay and Sport Chek impose a shipping charge of 5.95$ and 9.95$ for orders of less than $70 (Forrester, 2013b). In general, the major factors that drive order fulfillment costs in Canada are 1) premium transportation service to meet delivery promises; 2) labor costs for order management processes; 3) shipping delays or transportation issues (Oracle Corporation and Capgemini, 2013). For one fifth of Canadian retailers, fulfillment and shipping improvements were in the top three initiatives and priorities for their online business in 2015 (Mulpuru, 2015). More and more retailers see the benefits of reviewing their distribution

network designs to obtain more cost-effectiveness and provide better service levels to customers across Canada. These processes take tremendous time and investment, often requiring consultants to run sophisticated algorithms to decide on an alternative network design that supports long-term growth and productivity objectives (RCC and IBM, 2004).

B. Online retailing operation

Back in 2000, Internet retailers were classified and described based on their corporate origin (Paul and Pota, 2000; Oinas, 2002). Paul et al. and Oinas suggested that there are various retailer types according to their online presence. These include 1) online retailers with no other channels of distribution; 2) traditional store-based retailers whose channels of distribution are regular retail stores; 3) catalog retailers that sell by mail or phone from a product catalog; 4) multi-channel retailers that have traditionally used both stores and catalogs (and, more recently, the Internet); and 5) wholesale suppliers that sell directly to the consumers (Paul and Pota, 2000). The features of their various services and offerings are distinct from one another (Berman and Thelen, 2004).

Figure 4 compares the digital distribution model with the traditional model that has a system safety stock of $k\sigma N$ units with N stores. According to Evers (1995), the single stocking point provides advantages in term of inventory cost . Hill et al. (2002) cite Evers' square root law theory to prove these advantages and suggest that the total safety stock would be reduced to only $k\sigma\sqrt{N}$ units if the N stores are substituted by a single stocking point. As a consequence, when the number of stocking points is changed from 4 to 1, not only is the inventory halved, but the related costs come down significantly as well.

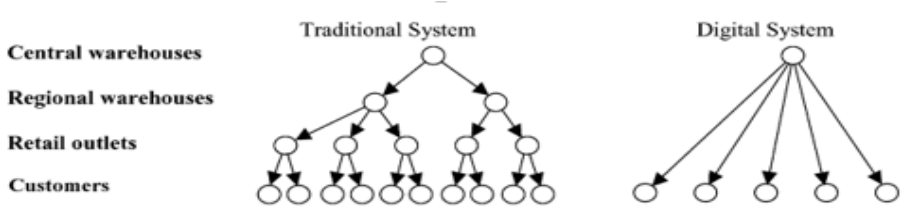

Figure 4: Traditional distribution system versus digital distribution system (Hill et al., 2002)

In an e-commerce context, the profiles of online shopping customers are different from those of offline shoppers in terms of demographic characteristics, preferences and behavior patterns (Fen and Guisseppi, 2008). The more knowledgeable that the shoppers are, the more motivation they have to shop online (Kim and Eastin, 2011). This difference requires that retailers redefine their relationships with their customers. Despite these differences, the fundamental aspects of retail business remain the same: 1) customers' needs are increasingly important, and 2) the physical distribution network become even more important in meeting online customers (Hübner et al., 2015). Consequently, the emergence of Internet businesses creates a need to restructure and develop the physical delivery of products as demand increases significantly (Gurau, Ranchhod, and Hackney, 2001). For example, realizing their weakness in inventory management compared to Amazon, traditional retailers such as Sears, Tesco, and Walmart has started drop-shipping from its suppliers to the customers directly to reduce complexity in fulfillment, delivery lead time and inventory management (Cameron, 1997).

Bernstein et al. (2008) show that Internet sales increase productivity by reducing transaction costs and increasing consumer surplus. Other studies on e-commerce suggest similar conclusions, but evidence for an increase in business profitability have not been found (Hitt and Brynjolfsson, 1996; Bernstein et al., 2008). Recent literature suggests that the conventional view of e-commerce as having positive impacts on business performance should be reviewed (Cao, 2014; HRC Advisory, 2016). This school of thought suggests that e-commerce benefits are probably overrated, whereas its negative effects (due to the inefficiency of e-commerce supply chains and particularly the costs of home delivery) are underestimated. According to these assumptions, the new focus of e-commerce must be optimization of the supply chains to serve consumers better and to reduce costs, and thus become more profitable (Yuan et al., 2011).

C. Emergence of multi-channel retailing

According to Industry Canada, the term "multi-channel retailer" describes a firm that "sells products and services directly to the public through more than one distribution channel" (Industry Canada, 2013). However, the term has been used primarily to refer to retailers that use both the Internet and physical stores (Hill et al., 2002; Carlson and O'Cass, 2011; Yan and Pei, 2012; Yang

et al., 2013). This has been a significant change from the past when multi-channel retailers were those that had both a physical store and a catalog (Paul and Pota, 2000).

As the online retail environment evolves, the literature documents a reverse trend: Internet- and catalog-based retailers look to add mobile channels and store channels to their business (Liu and Liou, 2011; Avery et al., 2012; Ono et al., 2012). Previously pure online retailers, such as the Seattle-based giant, Amazon, and the Montreal-based start-up, Frank and Oak, recently expanded their operations into physical stores (Newstex, 2016b, 2016a). Bell et al. (2012) suggested that for online retailers, growth lies in geographic areas where traditional retailers do not meet needs. Thus, customer acquisition methods can be customized according to demographics and location (Bell et al., 2012). Hesse added that successful customer acquisition depends on particular regional circumstances, such as consumer habits, delivery modes, and population density, while the question of the interaction of these factors is left unanswered (Hesse, 2002).

The multi-channel retailing literature suggests numerous benefits to converting from the brick-and-mortar model to the multi-channel model. A well-integrated multi-channel model enables consumers to examine goods with one channel, buy through another channel, and finally pick them up from a third one. Multi-channel retailing allows synergy and can result in an increased customer base, added revenue, and higher market share (Berman and Thelen, 2004). At the same time, retailers in transition face various significant complications and costs from implementing new strategies and operating both business channels.

D. Benefits and drawbacks of adding an online channel for traditional retailers

Although there are both benefits and drawbacks for traditional retailers to enter online retail offset, a single-channel retailer can focus its priorities to overcome many of the disadvantages. Classic theories of competitive strategy dictate that tangible and intangible assets of different channels can synergize to offer a competitive advantage (Porter, 1985; Steinfield et al., 2002). There are opportunities for leveraging retailer's assets and current relationships with existing suppliers for the new channels (Berman and Thelen, 2004). Mahar et al. and Paul et al. share the

view that firms could employ their collective assets and operations to improve cross-channel performance (Greenfeld, 1999; Paul and Pota, 2000; Zhang et al., 2010; Mahar et al., 2011).

Marketing theories focus on customer acquisition, market expansion, and channel coordination, and argue for paying more attention to the importance of channel harmonization (Friedman et al., 1999; Steinfield et al., 2002). The major benefits of this alignment include cost-effectiveness in developing a customer base through both physical stores and online stores (Greenfeld, 1999; Paul and Pota, 2000). The market for store-based retailers remains bounded by the area where the store is located, but the Internet allows customers to expand their reach to national and international retailers (Paul and Pota, 2000; Zhang et al., 2010). The existing brand recognition allows and enhances personalized marketing efforts, cross-selling, and cross-promotion (Greenfeld, 1999; Paul and Pota, 2000; Berman and Thelen, 2004). Customers that are familiar with a store may be more likely to purchase products from its website and vice versa (Paul and Pota, 2000). This cross-channel buying would increase revenue for the integrated business (Pentina and Hasty, 2009). Moreover, product selection and packaging allow a retailer to specialize products for each channel as well as to offer common product portfolios across channels (Paul and Pota, 2000; Berman and Thelen, 2004). Berman and Thelen (2004) also emphasize the need to keep consistent pricing policies across channels except for shipping and handling charges for delivery. The combination of all sales channels increases economy of scale, enhances retailer's buying power substantially, and lowers price (Paul and Pota, 2000).

Customers have more benefits and are more satisfied as the inventory shortages of one single channel are overcome. The physical store becomes a customer service center, for pick up, exchanges and returns, in addition to fulfilling the traditional role of a place for physical interaction with the products, personal services, payment in cash, entertaining, and purchasing on the spot (Greenfeld, 1999; Paul and Pota, 2000; Zhang et al., 2010). Proper store atmosphere also provides a better connection between product and customers to further enrich their experience and thereby increase the time spent in the physical store (Puccinelli et al., 2009; Agnihotri, 2015).

In general, there are four main categories of multi-channel retailing benefits: (1) lower costs; (2) differentiation through value-added services; (3) improved trust, and (4) geographic and

product market extension (Granovetter, 1985; DiMaggio and Louch, 1998; Steinfield et al., 1999; Steinheid and Klein, 1999; Steinheid and Whitten, 1999; Steinfield et al., 2002).

On the other hand, there are downsides when all sales channels integrate. Firstly, online profitability, determined by how much resource a channel consumes and how much return on investment it brings, might be lower. It is observed that online channels lose a significant proportion of profit on small sales due to the cost of sending a small parcel to a customer's door (Paul and Pota, 2000; Zhang et al., 2014). For the first years of an online channel, they usually sustain losses, and therefore a physical store will in most cases be the source of funding for the online channel (Paul and Pota, 2000; Zhang et al., 2010). Secondly, the online channel potentially reduces store traffic, thus reducing the sales and revenue from the store channel, lowering profit, and eventually minimizing the store presence if online sales become dominant (Paul and Pota, 2000). Thirdly, consumer channel preference and shopping behaviors are becoming more fragmented and more difficult for firms to satisfy in an e-commerce context. Multi-channel shoppers that purchase across different channels of the same retailer may be less brand-loyal and thus might reduce multi-channel retailers' profit levels (Berman and Thelen, 2004). Fourthly, the lack of profitability from online stores may lower a company's stock price (Paul and Pota, 2000).

Different channel strategies and operations requirements necessitate different sets of expertise and resources to achieve financially efficient operations (Bahn and Fischer, 2003). As contrasted by Perl and Sirisoponsilp (1998), centralized replenishment for store and fulfillment for small customers are not identical processes. Store DCs are designed for replenishment of the traditional channel, and therefore, the handling time of merchandise at DCs is minimized due to the minimum split required despite the large volume of merchandise. However, for the Internet channel, there is a large workload related to handling small units, such as picking, sorting, repacking, and shipment to each customer (Perl and Sirisoponsilp, 1988).

Additionally, the traditional store retailers are less likely to have the advanced information systems that allow the new online channels to compete with other modern online retailers, e.g., in sharing customer, price, and inventory data (Berman and Thelen, 2004). These existing barriers to

online transactions might lead to losing customers who are unfamiliar with or uncomfortable with computers (Griffiths and Howard, 2008).

To facilitate a strategic shift, retailers should optimize rather than merge their activities across channels (Cao, 2014). Many businesses face strategic modifications in terms of the redefinition of target clients, redesign of the value chain, and revision of their distribution system (Cao, 2014; Melo et al., 2014). There are three fundamental decisions at the core of distribution network design: facility location, means of transportation and inventory (Perl and Sirisoponsilp, 1988). Hence, the following factors are key for a distribution network: 1) number and locations of DCs; 2) allocation of customers or markets to DCs; 3) flow pattern from the suppliers to DCs; 4) selected transportation services between plants and DCs; 5) levels of inventories at the DCs. It is a major challenge for multi-channel retailers to optimize the balance between facility, transport, and inventory costs. Some distribution networks require making strategic decisions, such as changes in network structure or ownership. (Chopra and Mieghem, 2000). These operational challenges are the major motivations to have a separate system or to employ third-party logistics (3PL) to manage the new channel, which would increase the complexity of synchronizing the networks.

In general, each channel presents a unique combination of strengths and weaknesses for the retail supply chain. Various researchers have observed that while a multi-channel model creates complications in operations management for retailers, a more extensive store network and online presence helps to grow sales (Pentina and Hasty, 2009; Xia and Zhang, 2010). Retailers that offer products across various channels have more opportunities to take advantage of their strengths, leverage current assets, make more sales and earn more profits. The downsides of having Internet channel sales are the time lag between ordering and delivery and the shipping cost (Bell et al., 2014). Additionally, high costs for operating, customer acquisition, investing in fixed assets, low pooling potential, slow growth in sales, and lack of profit due to returns are the main reasons an online channel fails (Tarn et al., 2003)

E. Changes in the retail supply chains in adding an online channel

The new dynamics of the online channel cause tremendous changes across supply chain stages for retailers (Tarn et al., 2003). They transform the retail businesses in four respects: activities and processes, ownership of the network's assets and products, cost structure, and efficiency of the core supply chain activities. Based on a recent survey of various retailers (Anand and Grover, 2015), the following performance metrics are important to retail supply chains: (1) transport optimization; (2) inventory optimization; (3) information technology optimization; and (4) resource optimization (Table 3). These metrics confirm the omnipresence of time, service level, and cost.

	TRANSPORT OPTIMIZATION	INVENTORY OPTIMIZATION	IT OPTIMIZATION	RESOURCE OPTIMIZATION
INDICATORS	Delivery Time	Cost	Level of IT	Cost
	Frequency	Time	Service	Time
	Capacity	Quantity	Responsiveness	Service
		Service	Cost	Financial ratios

Table 3: Four groups of performance metrics for retail supply chains (Anand and Grover, 2015)

Due to the changes imposed by the new channel, the need to review and redesign the supply chains to eliminate inefficiencies is more pressing (Fingar, 2000). By placing the customer at the heart of its supply chain activities, companies must consider the trade-off between service level and supply chain costs incurred to meet those needs (Rabinovich et al., 2008). Finding strategies to balance these two factors is a pressing need for all retailers (Fen and Guisseppi, 2008). To achieve profit maximization, companies need to understand the impact of e-business on supply chain costs. Facility cost is an area where businesses can save by centralizing or decentralizing their fulfillment without any impact on order placement. Inventory costs change for those e-businesses that can centralize inventories because they do not have to carry inventory close to the customer. If various departments within the company can easily share demand and inventory positions, the retailer can reduce the bullwhip effect and improve coordination across the supply chains (Chopra and Mieghem, 2000). Perl and Sirisoponsilp (1988) divide the facility location, transportation, and inventory decisions into three different decisional levels as shown in Table 4 according to the strategic, tactical and operational decisions. For example, the decision of how to

handle material and equipment is a facility location decision at the tactical level, while how to assign a DC to a supply source is a facility location decision at a strategic level.

LOGISTICS DECISIONS	STRATEGIC	TACTICAL	OPERATIONAL
FACILITY LOCATION	Number of DC Assignment of DCs to supply sources Allocation of demands to DCs	Material handling of equipment	
TRANSPORTATION	Mode Type or carriage	Carrier Shipment size	Assignment of loads to vehicles Routing/Scheduling Crew assignment
INVENTORY	Total system of inventory Location of inventories	Size of inventories at various locations Level of safety stock at different locations	Control disciplines at various location

Table 4: Classification of facility location, transportation, and inventory decisions into three hierarchical levels (Perl and Sirisoponsilp, 1988).

Frohlich et al. (2005) suggest that there are two major decisions in designing the online fulfillment process: the design of the distribution network and the tactical operations planning. Firstly, and strategically, the retailer needs to decide from which facilities their products would be shipped. Secondly, regarding tactical planning, a retailer needs to design their fulfillment operations, including such steps as the picking of orders, the optimizing of quantities, order assignment and allocation, order shipping, orders tracking, etc. According to Frohlich et al. (2005), scalability and volume greatly influence the planning of fulfillment and distribution decisions. At a certain volume, stores-based fulfillment is the better choice. However, as demand increases tremendously, centralized fulfillment shows more efficiency due to the economies of scale.

F. Distribution network and online order fulfillment

Chopra (2003) suggests that the determinants of the distribution network include response time, product variety, product availability, customer service, convenience for order tracking, and convenience for return. Response time is the time window between order placement and order delivery. Product variety refers to the number of products offered to the customer from the distribution network. Product availability is the probability of having the inventory to fulfill the order. Customer service is the level at which the company's service meets the expected experience in placing and receiving orders from customers. Convenience for order tracking is the visibility

that allows customers to track the time and stage of the delivery. Convenience for return is the ease with which the customer can return undesired merchandise (Chopra, 2003).

A centralized distribution system is a system that employs an inventory model at the centralized stocking point and serves customers with different products, locations, and markets (Bendoly et al., 2007; Wanke and Saliby, 2009). In a general context, the important benefits of centralization are numerous. The inbound transportation costs, new facility investment costs, inventory costs of safety stock, and value-added services costs are reduced, while service level and the negotiating power for outbound transportation services increase. The factors that favor decentralization are better lead time for fulfilling orders, reduction of transportation cost from stocking points to customers, and better availability of stock resulting in increased sales (Patton, 1986; Teo et al., 2001).

1. CENTRALIZED DISTRIBUTION NETWORK DESIGN AND SUPPLY CHAINS COST

Various researchers highlight the impact of location and the consolidation effects of inventory centralization. Previously, centralized inventory was a popular choice in distribution management. The safety stock and average inventory decrease linearly with the number of warehouses while the average safety stock is a non-linear increasing function of the number of locations based on the "square root law" (Maister, 1976; Bowersox, 1978; Wanke and Saliby, 2009). Wanke and Saliby (2009) highlight how centralized distribution and inventory pooling effects lead to better customer service given the demand variability. As demand is aggregated from various different locations, the pooled inventory allows the system to be agile in serving a different market segment when demand changes. Zinn et al. (1989) measure the reduction in aggregate safety stock made possible by centralizing inventories and show that this does not depend on the variety of demand in locations that are being considered for centralization or decentralization of inventories.

Das and Tyagi (1997) determined the optimal degree of centralization in evaluating the trade-off between inventory and transportation costs, but observed that there is a big gap in the literature regarding how companies should centralize their inventory. Regarding inventory holding

cost, the same school of thought agreed that it is lower at a DC than it is in a store (Zinn et al., 1989; Bell et al., 2014). Excluding shipping costs, it is usually substantially less expensive to operate a system with centralized fulfillment than a system that holds inventory in each store (Bell et al., 2014). Evers et al. suggest that not all inventory items would be equally affected by consolidation (Evers and Beier, 1998).

Chopra (2003) finds that changes to the distribution network design affect the costs of supply chains factors such as inventories, transportation, facilities, handling, and information. As demonstrated in Figure 5, there is an inverse relationship between the number of facilities and the desired response time. However, Figure 6 shows that the more facilities that a supply chain has, the more inventory and inventory costs they have to carry while transportation costs are kept constant. For instance, in one study, Amazon had only a few facilities and achieved an inventory turn of 12 times a year, while Borders' 400 facilities gave them only two turns in the same period (Chopra, 2003).

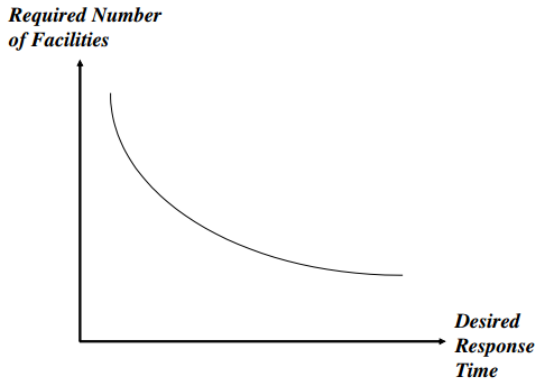

Figure 5: Relationship between desired response time and number of facilities (Chopra, 2003)

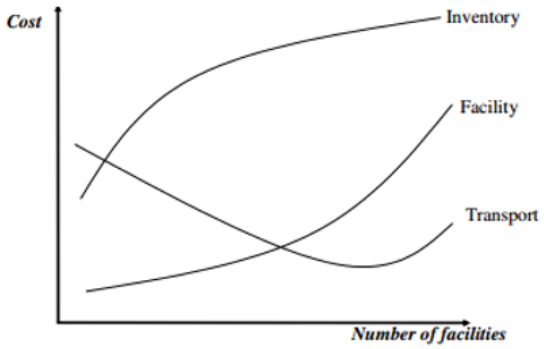

Figure 6: Relationship between number of facilities and logistics costs (Chopra, 2003)

In examining more key factors involved in the distribution management, Wanke and Saliby (2009) suggest centralizing slow-moving items to keep a system's holding costs down while simplifying the replenishment processes while Chopra (2003) provides a framework to identify critical dimensions that measure the performance of any distribution network.

2. MULTIPLE LOCATIONS FOR INVENTORY

Another school of thought argues for multiple locations for inventory. Ballou and Burnetas (2003) built on the concept of the virtual inventory, where a retailer fills customer demand from comparable alternate inventory locations when an item is out of stock at its "primary stocking point." Their virtually centralized warehouse concept assumes that each existing facility serves as a central warehouse. This method of redistributing stock on hand to stocking points that cannot meet customer demands is defined as lateral transshipment (Tagaras, 1999). Apart from stock moving effects, inventory transshipment allows supply chains to be agile (Evers, 1995; Herer et al., 2006; Nonaas and Jörnsten, 2007; Torabi et al., 2015). Hence, there will be no additional investment costs for the warehouse if the retailer can handle the extra inventory. However, the shipping network in this model requires more links than the centralized system since each store may serve as a central warehouse to any other store (Schneider and Watson, 1997). When orders can pool inventory in this system, there is less need for total system inventory. Ultimately, the retailer can achieve a higher fill rate. However, while less safety stock is needed, the regular stock may rise from the cross-filling of demand (Ballou and Burnetas, 2003; Wanke and Saliby, 2009).

Regarding the management of an inventory network, there are two approaches to stock pooling: reactive transshipments respond to shortages at a location by moving inventory from elsewhere within the network, and proactive stock redistribution seeks to minimize the chances of future stock-outs (Wanke and Saliby, 2009; Paterson et al., 2012). Wanke and Saliby (2009) demonstrate how, thanks to virtual inventories, regular transshipment helps to achieve higher fill rate levels, drive down shortage and stock-out costs, and allow for better management of total costs. Landers et al. (2000) propose a framework to assess enabling technologies, develop a conceptual framework, and identify the essential decision-support modules of a virtually centralized warehouse.

3. STRATEGIC OPTIONS FOR ONLINE ORDER FULFILLMENT

This section will highlight the chosen strategic fulfillment and distribution strategies in the existing literature. There are various important elements for retailers to consider in choosing an appropriate level of integration in the distribution network. The decision between integrated or

separated networks is an important one that influences the interdependencies of the important factors of the network (Hübner et al., 2015). Inventory management, warehouse operations, transportation and capacity management are main elements that will be arranged distinctively based on the chosen network structures. Integrated networks have the advantage of inventory pooling, while separated networks benefit from picking efficiency. Hübner et al. (2015), however, do not consider the relationship between capacity limit and the other planning tasks to be as significant. Lummus and Vokurka (2002) suggest that the more important business decision is the implementation of a process to deliver the ordered products to the customer quickly and cost-effectively.

Previous empirical research has examined successful and unsuccessful click-and-mortar strategies (Chavez et al., 2000; Chopra and Mieghem, 2000; Agatz et al., 2008). Good online fulfillment decisions create a competitive advantage for online retailers. (Lummus and Vokurka, 2002). In terms of facility ownership, Lummus and Vokurka (2002) propose six options ranging from self-ownership to outsourcing the fulfillment function: 1) distribute from an existing DC; 2) Acquire a dedicated online fulfillment center; 3) use a third-party online fulfillment service provider; 4) ship directly from the supplier to the customer; 5) pick and ship from existing retail stores; 6) ship to a local store or central pickup point. These options determine the impact of e-business on supply chains costs, and understanding them enables managers to make two key decisions when designing a distribution network. First, will the product be delivered to the customer location or picked up from a preordained site? Second, will the product flow through an intermediary or intermediate location? (Chopra, 2003). Similar studies suggest that retailers determine the separation level amongst the channels (Wu and Wu, 2015) based on the supply chains' capabilities (Lummus and Vokurka, 2002), the choices of inventory ownership (Snyder, 2013) and their impacts on profit margin (Mahar et al., 2011). Wu and Wu (2015) summarize existing literature and suggest that there is no single best option for any retailer.

The two key decisions of online distribution and fulfillment network designs are further sub-divided based on the method of moving products from retailer to customers (Lummus and Vokurka, 2002; Chopra, 2003). Figure 7 describes the following: 1) manufacturer storage with direct shipping or drop-shipping; 2) distributor's dedicated facility with package carrier delivery;

3) distributor's shared facility with package carrier delivery; 4) distributor storage with last-mile delivery capabilities; 5) manufacturer/distributor storage with customer pickup; 6) retail storage with customer pickup; and 7) retail storage with package carrier delivery.

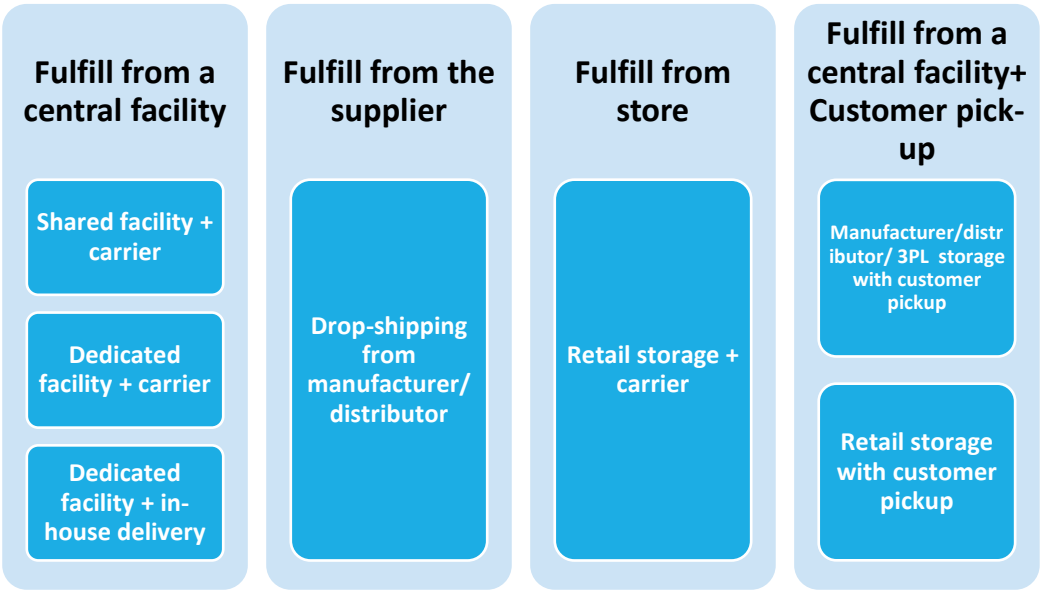

Figure 7: Options for fulfillment centers for multi-channel retailers (Lummus and Vokurka, 2002; Chopra, 2003)

Each of these models requires its own focuses on different capabilities of supply chain management. Some researchers have discussed the concept of "discreteness-based choices" for click-and-mortar stores to demonstrate these diverse strategies (Steinfield et al., 1999; Sengupta, 2000; Hill et al., 2002; Steinfield et al., 2002; Bendoly et al., 2007; Wu and Wu, 2015). Other researchers proposed that the integration-separation decision is not an either-or choice as there is a spectrum of the degree of integration, depending on the ability to switch channels and add a new channel (Gulati and Garino, 2000; Kauffman et al., 2009).

a) Fulfill from a central facility

Developing an efficient system that handles both customer-direct delivery and conventional retailing operations is of interest to firms trying to keep overall distribution investments and costs as low as possible. (Boyer et al., 2002). Considering the huge set-up cost of a central fulfillment facility in a new market, a much higher volume is required to justify the operating costs from all central fulfillment facilities (Alaimo, 2001)

(1) Dedicated facility and in-house delivery

Amazon offers a world-class example of having a dedicated facility and in-house delivery for certain regions (PWC, 2012). According to Lee and Whang (2001), Amazon's model allows dematerialization and commercialization to replace the physical flow. Moreover, maintaining internal control of the supply chains means having massive data from the operations and using it to optimize the entire fulfillment operations. Moreover, Amazon Canada employs various carriers to deliver ordered merchandise. Aside from their own in-house fleet, Amazon Logistics, Amazon uses several national carriers, including CEVA Logistics, Canada Post, DHL, Dynamex, FedEx, Intelcom, Purolator's Express and UPS (Amazon, 2016).

The online shoe store Zappos, as shown in the PWC report, is well-known for its returns policy and reverse supply chain. Its centralized fulfillment enables the operations to put returned inventory back into the system for fast and convenient returns (PWC, 2012). Impulse purchase shoppers appreciate this feature. As suggested by White (2016), meeting customers' needs and managing returns efficiently are two important winning strategies for online retailers.

(2) Dedicated facility and outsourcing carrier

Channel separation allows the retailer to focus on single channel efficiency. The downside of this arrangement is the huge investment and inventory cost. As suggested by Lee and Whang (2001), retailers who ship from physical stores may not be capable of fulfilling a high volume of online orders economically and efficiently. In general, there are three reasons for companies to opt for this option. Firstly, the operational differences of online channels offer efficiency, speed, and accuracy in fulfillment while the physical stores' supply chains are characterized by good management of large volumes of inventory, accurate demand forecasting and high availability of products. Secondly, for companies whose existing supply chains are complex and whose expertise in online business is not deep enough, such as Walmart, dedicated fulfillment and distribution allow for lower costs and higher service level (PWC, 2012). Thirdly, this choice is justified when both sales channels accumulate sufficient scale and it is no longer economical to combine both channels in one fulfillment process.

(3) Shared facility and outsourcing carrier

According to Dell's experience, this approach is optimal only if both the physical and online retail store have similar customer requirements and logistics system (PWC, 2012). Dell's initial success encouraged the company to extend selling its computers through physical retail channels, using its existing direct-to-consumer supply chains capabilities. This leveraged shipment strategy is ideal for products with stable demand and where the delivery value density of the existing delivery network is unlikely to change (Lee and Whang, 2001). Dell's failure proved that unstable demand volume, shared facility costs, and using costly 3PL shipping services to expedite shipment disadvantaged its cost structure. Quidsi, a company that owns various online stores, has a shared in-house fulfillment capability for all of its sales channels. This creates the economy of scale and predictable demand which justifies the investments for their highly specialized infrastructure and processes (PWC, 2012).

b) Drop-shipping fulfillment from manufacturer or distributor

In this model, vendors deliver directly to the customer instead of flowing through the retailer's distribution network. Most short shelf-life and bulky products are drop-shipped. This strategy simplifies the retailers' operations and reduces inventory risk while increasing delivery efficiencies. The ability to rethink inventory placement and delivery gives these retailers an advantage in conducting business (White, 2016).

c) Fulfill from store

Also, known as ship from store (SFS), the fulfillment from the store model is considered a competitive strategy for multi-channel retailers who already have a network of established physical stores (Forrester, 2016). This approach involves the conversion of existing stores into virtual facilities to make use of the local retail network to fulfill online orders in their areas. This is expected to be faster, less expensive in terms of outbound transportation costs, and more efficient than shipping small parcels from DCs to a customer (Sheldon et al., 2014). Bendoly (2014) claims that the major benefit of this model is the inventory pooling effect for all channels in the face of uncertain demand. Sheldon et al. (2014) propose that the ability to mitigate the risks of assortment planning in using virtually centralized inventory increases online revenue by 10% to 30%.

In contrast, Chopra (2013) points out that the downside of this model is increased inventory costs due to the individual stocking systems. Chopra, however, fails to consider the possibility of virtual aggregation from the total inventory of all local storage. For example, Best Buy cut average online delivery times by two days by using the combined inventories of over 1,400 stores to fulfill orders (Sheldon et al., 2014; Guy, 2016).

d) Manufacturer/distributor storage and customer pick-up

In this model, inventory from the manufacturer's or distributor's warehouse is picked and packed before sending to pick-up points for customers to collect. This model is used by stores such as 7dream.com, operated by 7 Eleven Japan (Fulford, 2000). Chopra (2013) suggests that transportation costs for this arrangement are lower than for other models using package carriers. These savings come from the "significant aggregation" inherent in using TL or LTL carriers to transport orders to the pickup site. BAM retailers who have a large network of stores have great advantages with this approach, as they can use their existing stores as pick-up points for local customers. Other 3PL that provide pick-up solutions, such as Canada Post, Purolator's Express, Amazon Locker and Inpost24 Locker, are alternatives for existing pick-up sites used by Canadian retailers. Visibility of order availability for the customer to pick-up is essential for all parties involved in the process. In exchange for lower shipping cost, customers face constraints such as limited time for pick-up, transportation, and the costs to travel to pick-up sites. On the other hand, customers can choose to pick up orders at a convenient time instead of staying home to await a delivery (Chopra, 2003).

e) Retail storage with customer pick up

Similar to SFS, in this approach, inventory is stored locally at retail stores and used to fulfill online orders. Online orders are picked and packed by the retail store. The significant difference in this model is that customers order online and then pick orders up at the store. Canadian Tire offers pick-up at the store for orders placed online. Many other retailers offer both SFS and pick-up in-store. As with SFS, retail storage with customer pickup allows lower transportation costs as store replenishment is also used to fulfill the online sales' inventory. Similar to pick-up from a predesignated site from the manufacturer, pick-up from existing retail stores

would lower facility costs. However, there are processing costs incurred in identifying the order and the customers. In both SFS and this option, merchandise can be returned at the store. SFS allows a faster response, which is ideal for faster-moving items or those which tend to be urgently demanded by customers (Chopra, 2003).

4. EVALUATING DISTRIBUTION OPTIONS FOR MULTI-CHANNEL RETAILING

Various researchers have focused on evaluating distribution options for multi-channel retailing. Agatz and Fleischmann (2008) reviewed the current state of research in online fulfillment and multi-channel distribution. They conclude that there is room for significant contributions in all areas of online fulfillment research, particularly those that examine the interactions between online fulfillment and other distribution channels. Hill et al (2002) observe that as companies increase their "customer touch-points and service delivery channels," their operations have more variables. Thus, it is more difficult to examine the trade-offs from one channel to the other and the cost effectiveness. Although multi-channel retail appears to be emerging as the dominant business model, there is no dominant distribution method being employed to handle these multi-channels (Hill et al., 2002; Bendoly et al., 2007). Nonetheless, in developing and revising fulfillment and distribution strategy, it is important to examine internal factors, such as efficiency, and external factors, such as customers' perceptions of service level (Chase, 1978; Hill et al., 2002; Xia and Zhang, 2010). Lummus and Vokurka (2002) propose a set of criteria to assess alternative options for building a successful online fulfillment operation.

In the evaluation process, the capital investment and operating costs of additional warehouses play an important role. There is evidence that a centralized warehouse may be advantageous in terms of holding costs and transportation costs for expensive, low-demand item orders, as opposed to inexpensive, fast-moving items. Hence, whether a warehouse can reduce overall cost depends heavily on the additional cost of the centralized warehouse (Schneider and Watson, 1997). Schneider and Watson's virtual centralized warehouse concept is popular amongst Internet retailers and multi-channel retailers who see the benefits of an existing network of retail stores.

Various analytical models have been proposed to study multi-channel retailing supply chains, the feasibility of investment in their fulfillment capabilities, and the impact of such investments on inventory (Johnson and Whang, 2002; Swaminathan and Tayur, 2003). Alptekinoğlu and Tang (2005) propose a model by which newly-converted click-and-mortar retailers might determine the ordering and allocation of incoming orders among sales locations so that total expected distribution costs are lowest. Bendoly et al. (2007) consider a two-echelon fixed period inventory system that minimizes the total cost and determines when and if decentralization of online inventory is ideal, and if so, the optimal degree of decentralization for all stores. Their model requires that one knows total system costs, including the fixed costs of setting up operations, the variable shipping and handling costs, and the inventory holding cost for all inventory in the system (Bendoly et al., 2007). Teo et al. (2011) suggest that consolidation of distribution and inventory leads to lower total facility investment and inventory costs. However, for a general stochastic demand case, the total facility investment and inventory costs of a consolidated system might be worse than that of a decentralized system.

Based on transaction cost theory, Rabinovich et al. (2007) reveal that low levels of asset specificity and high uncertainty of demand drive online retailers to establish relationships with logistics service providers in outbound distribution. Logistics service providers offer many complementary logistics services across new and existing relationships between Internet commerce firms, their customers, and their vendors. Boyer et al. (2002) cite Webvan as an example of failure to form beneficial relationships. Per Boyer et al., in the case of Webvan, savings due to inventory improvement from centralized distribution were "negated by losses in other areas – most notably vastly increased shipping costs."

Mallen (1996) provides a guideline to quantify strategic options and select an appropriate channel based on the company's products' market characteristics. Each option is evaluated based on its gross margins and its return-on-investment analysis. Mallen (1996) also suggests that the more direct and more important the channel, the greater the investment required by the company. De Koster (2003) provides a more detailed guideline on tactical distribution for delivery operations. This research, however, did not take transportation costs into account for performance measurement. Firm resource-based view holds that a click-and-mortar retailer needs to examine

its capabilities by evaluating two major options: 1) using their current distribution network; or 2) building an independent delivery network to meet on-line demand (Wernerfelt, 1984; Boyer et al., 2002). Swaminathan and Tayur (2003) propose that a retailer must make decisions related to its distribution network, the location and the quantities of related facilities (e.g., the DC and retail outlets), the design of transportation modes and routes, and also the benefits of exploiting risk-pooling opportunities to optimize business performance. In evaluating these strategies, click-and-mortar firms can realize benefits by combining inventory for online sales and stores. Facility costs are reduced greatly when physical interfaces with customers are reduced (Anders, 1998). However, in many situations, there are disadvantages to being virtual, such as greater customer confusion when seeking to return merchandise or interact with the business, and the lack of a visible brand and market presence.

The reformulated Inventory-Theoretic model (Langley, 1980; Perl and Sirisoponsilp, 1988) demonstrated some interdependencies between demand and product characteristics, such as size, weight, inventory cost and transportation cost. Total direct transportation cost is positively correlated with demand, while product value is negatively correlated with optimal shipment size as part of the inventory carrying cost effect. This model also re-examines the validity of the claim that "minimizing direct transportation cost would result in lowest total costs" (Langley, 1980; Perl and Sirisoponsilp, 1988). Langley suggests that this relationship is dependent on variables such as transportation rate, shipment size and the value of the product. Lee and Whang (2001) suggest that for high-value products, where the ratio of product value to shipping cost is high, it is simpler to ship from one source to all customers directly. Thus, for companies with complex assortments and shorter delivery lead times, having the transport planning in-house is more efficient for local and regional delivery. Agatz et al. (2008) propose that hub-and-spoke networks can create economies of scale for expanding geographical coverage. Wanke and Saliby (2009) observe that consolidation into one single stock location often requires expedited delivery and makes transportation costs more relevant.

Other researchers propose a hybrid approach, in which the fulfillment structure differs by product (Yrjölä, 2001; Yrjölä et al., 2002). A company such as Grainger, which has a stocking system of approximately 100,000 SKUs, can ship fast-moving products within a day from the

order-placing time and design a central stocking and fulfillment point for the remaining slower moving and non-stocked products. Schneider et al. consider the strategic decision of adding a central warehouse to a network of stores to supply non-stocked, slow-moving, and expensive items while fast-moving, high-demand and inexpensive items ship from decentralized locations (Schneider and Watson, 1997; Chopra, 2003).

For these reasons, the nature of sales occurring online (Chopra, 2003), the company's business environment, the characteristics of products (Lee and Whang, 2001) and operating costs (Schneider and Watson, 1997; PWC, 2012) are key in this decision. Store-based fulfillment may be best-suited for short-term profitability or for preventing additional loss while a central facility provides higher efficiency and flexibility (Murphy, 2003). Firms that target customers who can tolerate a longer response time need fewer locations. Firms that target customers who value shorter response times need to locate these facilities closer to the customer. Empirical data are consistent with the hypothesis that this tendency is higher for older firms selling smaller, higher-margin products, offering lower levels of product variety, or facing lower demand uncertainty (Randall et al., 2006).

G. Tactical planning for online order fulfillment

At a more tactical level, and taking into account DC operations, the fulfillment process involves order management, storage, picking, sorting, packaging, shipping, handling, delivery, inventory management and customer care (Saenz, 2001; Lummus and Vokurka, 2002; Tarn et al., 2003; Yuan and Grant, 2006).

According to Saenz, three main areas of the fulfillment process are affected by Internet orders: picking, packaging, and returns (Saenz, 2001). A successful online fulfillment operation, according to the same author, involves seven factors demonstrated in Figure 8 below. Among these, the first two (operating a high-frequency, open-case picking area and using advanced picking technologies) require automated technology for high volume picking, which necessitates fulfillment from a specialized DC. Saenz fails to consider using another fulfillment center as an option.

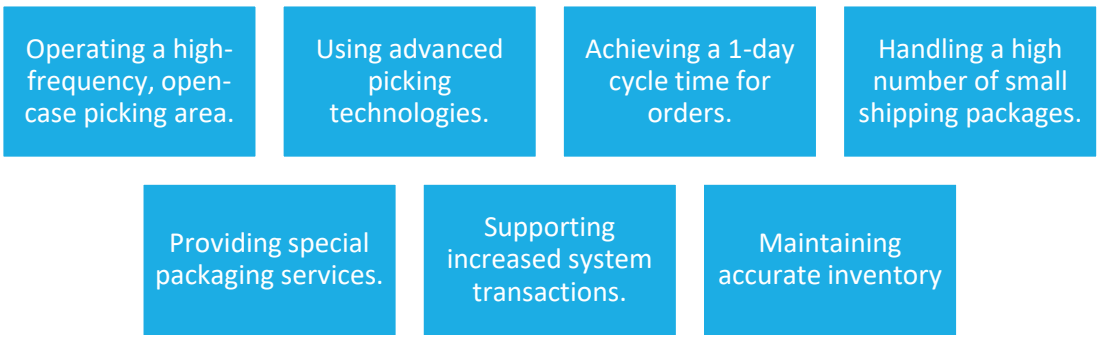

Figure 8: Successful e-fulfillment operations (Saenz, 2001)

Frohlich et al. (2005) and Meller (2015), in considering fulfillment activities from all types of FCs, propose three online fulfillment activities: ordering, order processing including picking and packing, and order delivery. Frohlich et al. (2005) study these activities in greater details (Table 5).

ORDERING	PICK AND PACK (IN-STORE VS. DC)	DELIVERY
• Required convenience and little assistance from retailer • Easier ordering process for regular shoppers • Accuracy of information plays a big role • Hotline to customer service while enabling automated ordering and communication process to enhance service level	• Larger product range and more picking methods yield different productivities and accuracy • Challenges for picking and packing large individual items at stores vs. DC • More frequent and faster inventory turnover at DCs cost saving shipping and stocking from stores.	• Direct vs. indirect • Density influences delivery scale • Order and delivery time affect productivity • Drop boxes could enhance delivery productivity • Trade-off between cost, productivity and customer satisfaction

Table 5: Elements of last-mile supply chains (Frohlich T. et al., 2005)

1. THE ORDERING PROCESS

For multi-channel and pure online retailers, order placement is the first event triggering fulfillment activity. At this stage, the customer sees the convenience of interacting with the online store through a well-built information system. There is no requirement for real-time assistance from the retailer for this process. Most online shopping portals have a faster process for repeat purchase shoppers. Once the order is finalized, the customer's order is sent to the online retailer to match with available inventory. The accuracy of inventory availability for purchase and delivery confirmation are essential (Frohlich et al., 2005).

2. THE PICK-AND-PACK PROCESS

The differences in fulfillment operations between store-based retailers and multi-channel retailers are summarized in three main categories: the product range, the productivity, and other factors in the pick-and-pack process (Frohlich et al., 2005).

a) Product Range

Every additional SKU complicates the inventory-management process as it increases complexity and product range, and takes more room in the limited shelf and storage space. Frohlich et al. (2005) suggest that it is hard to measure both the positive contribution of new SKUs, such as sales growth, and the negative impacts, such as cannibalization between products within the same portfolio and effects on inventory management. They go on to suggest two solutions to product range management for online retailers.

Firstly, they suggest product fulfillment from a specialized DC, which allows more ease in the inventory adding process compared to fulfillment from numerous retail locations. Less fluctuation in demand results in less safety stock thanks to the central location. Frohlich et al. (2005) uses the case of Amazon, which has roughly 2 million books in stock at six DCs. Best-selling stocks are carried widely in all stocking points, second-best in selected DCs, slower-selling items at only a single DC, and lowest-selling items are back-ordered from publishers and manufacturers.

Secondly, they suggest decreasing the number of SKUs to increase efficiency in fulfillment. As a result, availability of product choices decreases and substitutions go up as part of the trade-off. In Table 6, Frohlich et al. (2005) contrast a typical stock range of 8,000 to 10,000 items at DC versus the 20,000 to 40,000 items from a traditional grocery stock. FreshDirect, a New York-based grocer, chooses to carry only 4,000 packaged items at a certain size rather than a larger range of choices. This strategy claims an average gross margin of 40 percent higher for the special segment. Frohlich et al. (2005) expect that DC-based fulfillment yields better performance when it comes to substitutes, while store-based picking would offer more choice of products in managing its fulfillment to retain customers.

Industry	Home-Delivery	Grocers	Clothing	Office Products	Beauty Supplies
Pick from	In-store	DC	DC	DC	DC
Product Destination	Direct	Direct	Direct	Store Replenishment	Store Replenishment
Company(s)	Lowes Foods D'Agostinos Albertsons Safeway Tesco	Ocado FreshDirect Grocery Gateway PublixDirect	Value Vision FC (for Polo.com)	Sanford and Newell Office Products	Avon Canada
Pick Rate (Items/ worker hour)	80–120 items	150–300 items	67–100 orders	36 cartons	94 items
Accuracy	90%–96%	98%–99.5%	NA	99.5%	99.95%
Systems/Technology	NA	NA	6,500 feet of Powered Conveyor Automated Sorters	Warehouse Management Software (WMS), 2.5 miles of Conveyor with High-Speed Sortation, Pick-to-Light, Radio Frequency Data Communication Terminals	Flow and Bin Racks, Carton Forming System, RF and Bar Code Scanning, Warehouse Management System
Facility Size	NA	NA	280,000 sq. ft.	285,000 sq. ft.	80,000 sq. ft.
Volume	NA	NA	4,000–6,000 orders per day	1,425 orders per day	1.3 million orders/year
SKUs stocked	30,000–40,000	8,000–12,000	NA	6,450	8,500
Equipment Cost	$15K—$25K per store	NA	NA	$6 Million	

Table 6: Comparison of order picking rates, systems, and accuracy (Frohlich et al., 2005)

b) Productivity

Each channel is designed differently and thus has different productivity rates when it comes to small-size orders. The pick-and-pack operations of a BAM store are characterized by specific space layouts for aisle widths, aisle heights, forklift use, packing materials, and reverse logistics to deliver pallet-loads of goods. On the other hand, the pick-and-pack operations of online orders are designed to pick for direct shipment to the customers. As suggested by Frohlich et al. (2005), CAM operations also require products to be packed for individual parcel delivery "rather than loaded onto a large truck for delivery to a store".

Frohlich et al. (2005) also use the layout of an average grocery store to explain store-based operations and a productivity rate of picking. Fast-moving products such as milk are arranged at the back of the store, while impulse items are located in the more eye-catching areas. This layout is used to maximize customers' time in the store. Additionally, storage space is increasingly decreased to leave more space for sales areas. For these reasons, store staff who pick online orders in a store may disturb customers and have lower picking rates than at a dedicated online FC. The classic layout of stores is meant to serve customers inside them, and are not designed for the efficiency of sorting, picking, packing, and otherwise assembling items for online orders (Murphy, 2003; Frohlich et al., 2005; Sheldon et al., 2014). Consequently, picking from the store is more labor-intensive and costly than DC-picking is.

As shown in Table 6 above, in-store picking achieves lower volume (around 80-120 items per hour versus DC-picking, which is closer to 150-300 items per hour for grocery products). The accuracy of picking at DCs is also higher. Superior productivity rates are achieved by DC-picking because DCs are designed for an optimal rate of picking. Their storage systems and layouts minimize travel distances and effort in the presence of automated equipment and system (Frohlich et al., 2005).

c) Other factors in the pick-and-pack process

The traditional difficulties that constrain store fulfillment are often still problems for online fulfillment. Firstly, inventory record accuracy and in-stock rate are the most important factors.

Fisher and Frohlich et al. (2005) suggest that more accuracy in matching supply and demand would strongly influence a retailer's profit (Frohlich et al., 2005; Fisher, 2009). Secondly, "phantom stock-outs" occur when customer re-shelve items, causing lost sales and inventory liability even when the inventory is still in the store (Raman, 2000). It is expected that this problem will be amplified for online channel fulfillment especially when stores experience stock-outs. As phantom stock-out and inaccuracies happen more at stores than at DCs, Frohlich et al. (2005) imply that DC-based fulfillment will yield a lower percentage of substitutions overall.

3. THE DELIVERY PROCESS

When the purchase arrives at the customer's doors, the delivery activity is completed. The last mile, which includes product transportation to the customers, is the most important element of the order fulfillment process according to many authors (Bromage, 2001; Esper et al., 2003; Nicholls and Watson, 2005; Holdorf and Haasis, 2014), especially in redefining the role of the CEP service provider in replacing the in-house fleet. As defined by DHL (2003), CEP services are ideal for high shipping volume of relatively low weight parcels.

Previously, fulfillment efficiency has been measured across three dimensions: timeliness, availability, and condition (Mentzer et al., 1989; Emerson and Grimm, 1996; Bienstock et al., 1997). As the operations of logistics increase possible methods of delivery, other delivery variables, such as order-to-delivery cycle time and delivery window, also change (Gosso, 2005). Table 7 below summarizes the main differences between traditional delivery chains and e-commerce chains in terms of order size, shipping nature, and delivery characteristics. CEP services have underdeveloped capabilities (Nicholls and Watson, 2005) and therefore more inefficiency, making them an area of great potential improvements to enhance a company's financial performance.

Attributes	Traditional delivery	E-commerce delivery
Distribution chain	Producer-wholesaler-retailer	Online retailer-customer
Shipment size	Large	Small
Shipment type	Homogeneous	Heterogeneous
Number of loads (density)	High	Low
Number of delivery stops	One or more stops	Many stops
Delivery failure	Few	Many
Delivery frequency	Low	High
Delivery time sensitivity	Low	High
Number of vehicles required	Large	Small
Vehicle size	Large	Small
Delivery cost per each load	High	Small

Table 7: Traditional retail delivery versus e-commerce delivery (Nicholls and Watson, 2005; Yuan and Grant, 2006)

Drop-ship retailers usually contract one or various delivery companies to handle delivery activity (Rabinovich et al., 2008). If a retailer owns inventory but not the in-house fleet, the role of 3PL in shipping becomes more vital (Hsiao et al., 2010; Jiang et al., 2016).

Barsh et al. (2000) make a daring prediction about the future of online retailing, claiming that "pure-play Internet retailers haven't made a profit and probably never will. The winners on-line will be experienced retailers that can execute a multi-channel strategy" (Barsh et al., 2000). Consistent with this, there is an existing gap in the literature regarding the role of online fulfillment operations and logistics service providers (LSP) in a successful retail supply chain.

The literature suggests that shipping fees are the main factor influencing customer satisfaction and the culprit behind retailers' lost profits. Evidence shows that more than 60% of online shoppers abandon their cart when they see the shipping fee (Lewis et al., 2006). Shoppers tend to buy more while shopping online in order to qualify for free shipping. Various studies propose that delivery service at the right price helps retailers to incentivize higher order value density and optimize transportation costs to enhance delivery profitability (Yrjölä, 2001; Yrjölä et

al., 2002; Agatz et al., 2008; PWC, 2012; White, 2016). However, shipping fee schedule design is a relatively complex task that requires balancing the desire to recover shipping costs with the need to attract and retain a substantial customer base (Lewis et al., 2006).

Art (2000) and Rowlands (2001) explained this by highlighting online retailers' capabilities in delivering nationwide and the costly delivery service of CEP shipping providers. Art (2000) suggests that cost-effective, flexible materials handling would address these problems. There are three types of shipping fee policies: the unconditional free shipping policy, in which an online retailer absorbs the shipping costs for all orders; the contingent free shipping policy, in which a retailer pays for the shipping costs, but only for those orders that are equal to or larger than a specific order value; the fixed shipping fee policy, in which the consumers pay for shipping regardless of their order size (Dinlersoz and Li, 2006).

Based on a survey of 70 retailers, Nicholls and Watson (2005) demonstrate that if online sales are only a small portion of the total multi-channel sales, it is not too difficult to absorb the shipping costs of online orders. However, Nicholls et al. suggest that financial unsustainability is a reality for retailers whose shipping costs for online orders are not paid by the shoppers. For multi-channel retail business, the performances of the store channel and the online channel are not separated. Thus, it is unclear how to assess the profitability of the online channel.

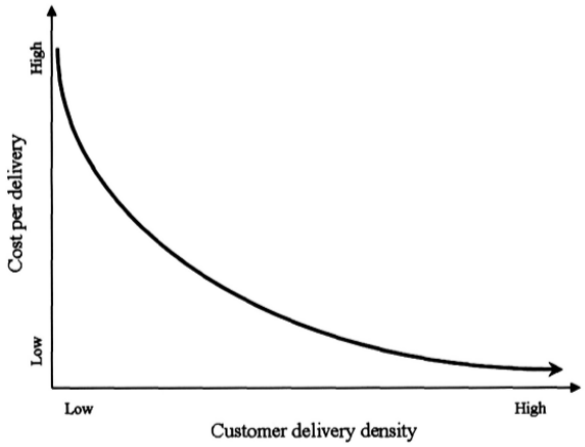

Figure 9: Relationship between delivery cost and delivery density (Frohlich et al., 2005)

Frohlich et al. (2005) show the negative correlation between order value density/customer delivery density and cost per delivery (Figure 9). Studying the problem in early e-commerce, Barsh et al. (2000), showed the pertinent trend of online fulfillment causing loss per order on various e-retailers.

These problems persist today. In the case of Amazon (Trefis Team, 2014b), increased fulfillment costs are the main reason for the downtrend in the company's operating margin in the period of 2009-2014. Analysts point to various factors related to unprofitable online fulfillment. Firstly, the expansion of fulfillment capabilities, inventory levels, and product mix have contributed to higher fulfillment costs. Secondly, third party sales have increased, which results in higher fulfillment costs, as costs are greater in proportion to profits for third-party sales than they are for Amazon's owned-inventory retail sales. Finally, the promotion cost of the Prime program is driving up the cost curve; Prime's free shipping costs exceed subscription revenues (Trefis Team, 2014b).

4. QUANTITATIVE STUDIES ON CEP SHIPPING SERVICE AND PROFITABILITY SHIPPING POLICIES

Retail pricing theory suggests that shipping fees greatly influence order incidence rates and graduated shipping fees significantly affect average expenditures. Specifically, Lewis (2006) indicates that customer acquisition is more sensitive to order size incentives while shipping fee has more impact on customer retention. White (2016) suggests that online fulfillment can enhance a firm's financial performance in linking customer behavior and supply chain strategies.

Many shipping fee schedule optimizations involve some forms of free shipping. The literature on free shipping and order incidence is very limited (Hua et al., 2012). Most of this

research has been in the B2B context (Russell and Krajewski, 1991; Swenseth and Godfrey, 2002; Ertogral et al., 2007). In general, the existing literature suggests that free shipping may induce buyers. An attractive free shipping policy can induce buyers to place larger orders less frequently, which allows the supplier to cut handling, order fulfillment, and production costs, enabling it to achieve economies of scale (Zhou et al., 2009). Quantitative models of optimal online fulfillment and multi-channel distribution mainly focus on delivery capacity for online grocers. The nature of these products as a perishable asset means that unutilized capacity on any given day is a lost revenue opportunity. An important component of revenue management is dynamic pricing (Agatz et al., 2008). Many of the shipping fee schedule optimizations involve anticipating the increasing demand during promotional periods (inventory management, pricing effects on volume, conversion rate of visitors and buyers) (Lewis et al., 2006).

5. RELEVANT LOGISTICS VARIABLES

There are five logistics variables which have an important influence on the cost structure of online sales fulfillment. These variables are related to 1) the order; 2) the logistical structure; 3) the service cost (Gosso, 2005). These may be external variables (EV) or internal variables (IV) which a company can proactively manage to achieve fulfillment efficiency. Table 8 below lists all the variables that are relevant to this study.

VARIABLES	SUB-VARIABLES	EV/IV	INFLUENCES
ORDER	Order value density	EV-IV	Defined as the value density of an order. It dictates the costs to make deliveries or pick up the order
	Size of order	EV-IV	Determines the ratio between transport costs and delivery stop costs that contribute to the overall cost of distribution
	Weight-volume of product	EV-IV	Influences the transportability of the product
LOGISTICS STRUCTURE	Characteristics of FC	IV	Influence the fixed and variable costs, the costs of delivering the merchandise from the local distribution point, and the costs of picking up ordered products from the shop
SERVICE COST	Differential cost between means of transport	EV	Expresses the difference in the cost incurred to transport a unit of product over a unit of distance with the different means available and where service standards are equal

Table 8: Logistics variables influencing the cost structure of online fulfillment service in this study (Gosso, 2005)

6. COST STRUCTURE FOR ONLINE FULFILLMENT AND DISTRIBUTION

Margins, by definition, denote the difference between the costs that are incurred by a retailer in acquiring and selling a product and the price that it charges customers when selling that product. On this basis, Internet retailers employing a 3PL service provider can calculate both product and shipping and handling (S&H) margins. Product margins reflect the price charged for the SKUs offered for sale, minus the cost paid to the supplier of the goods.

Rabinovich et al. (2008) suggest that online retailers can achieve more profits from positive S&H margins, arising from the difference between the S&H fees charged to online customers and the actual S&H costs paid to have products delivered to customers. Table 9 details the structure of the margins in the drop-shipping model (Dinlersoz and Li, 2006; Rabinovich et al., 2008). This model is highly applicable to the multi-channel retailer examined in this study. The cost structure below reflects a multi-channel retail business. The net margin of an online order is derived from the store margin minus the S&H margin.

Product margin		**S&H margin**	
Retailer revenue	Retailer cost	S&H fee	S&H cost
Price paid by the customer for the product	All costs paid to external parties, including the manufacturer and the suppliers, and costs incurred internally by the retailer's operation. Internal costs include the fixed cost of facilities and marketing expenses. The General and Administration Expenses include the variable costs of operating the retail business, such as inventory holding cost and overhead cost.	Shipping fee paid by the shoppers to have the product delivered to their desired destination	Includes two cost items: the shipping cost and the handling cost. Shipping cost is paid by the retailer for the outbound distribution to the dedicated 3PL that handles transportation of the individual parcel to the shoppers.
Total margins = Store margin + S&H margin. Store margin = retailer revenue-cost of sales (COS) - Fixed Cost – Marketing Fee – General and Administration Expenses (G&A). S&H margin = Shipping fee - handling cost-shipping charge.			

Table 9: Margin structure in the SFS model for the multi-channel retailer

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III. DESCRIPTION OF THE COMPANY

The Company is one of the largest apparel retailers in Canada, offering clothing, footwear, and accessories for both men and women that serve multi-purpose occasions such as everyday wear, business casual, work wear or sportswear. Having an established market niche for specialized apparel for men, and having successfully expanded their market position into women's casual apparel and footwear, it also has a strong market share in customized uniforms and healthcare apparel. The Company operates under different store names in different regions across the country. For confidentiality, the store map in Figure 10 below does not fully reflect the presence of this company.

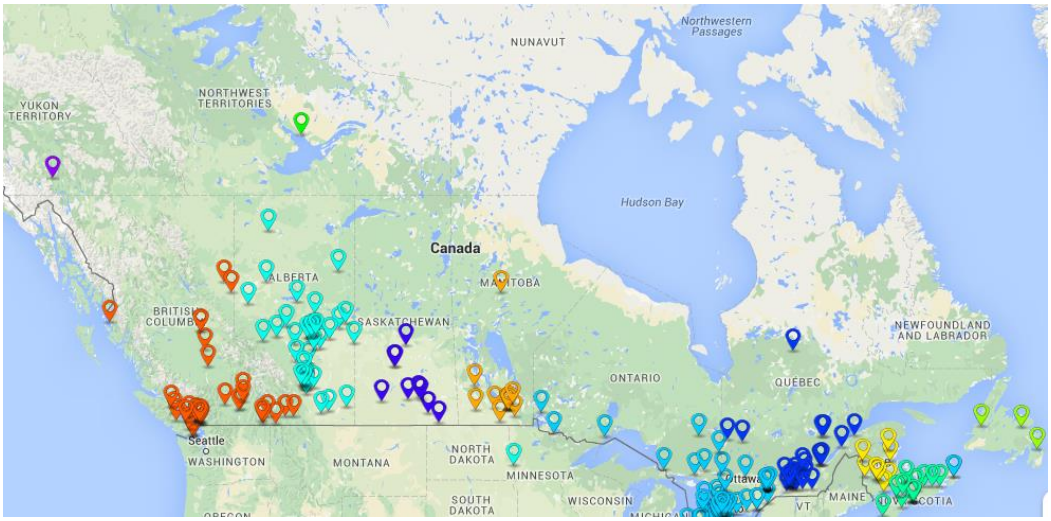


Figure 10: Store network distribution in Canada

1. COMPANY PROFILE AND BUSINESS STRATEGIES

In 2015, The Company's revenue was around one billion dollars. It currently has a few hundred stores located in all provinces and some territories in Canada. Some of these stores are clustered together with their holding company, with which it shares the same target customer groups. The Company owns and operates approximately 90% of the stores, while franchise owners operate the remaining stores. This strategic ownership gives them important access to certain local markets.

The Company has various sister companies that all belong to one of the largest Canadian retail corporations. This relationship allows The Company to take advantage of common business infrastructure and human capital to grow and achieve network expansion continuously within the existing retail network. The Company's general business strategy is to continue its strong performance in the core product offering while trying to expand its market share in non-traditional product lines.

The Company offers its new and innovative product portfolios across all product lines and all private brands, notably winter wear, sportswear, footwear, and safety wear. The operation and growth networks between various related retailers allow The Company to focus on its core customers, achieve its desired growth rate, and avoid cannibalism. Its priorities are to rejuvenate store networks, retain a current segment of customers, and capture new segments of customers, while at the same time focusing on increasing supply chain efficiencies of the CAM store network.

Most importantly in terms of operational strategies, The Company is looking at enhancing business performance while sharpening its multi-channel retailing network. Specifically, The Company believes that there is room for improvement in its distribution network design and online fulfillment strategies given the relatively young online channel. The Company is willing to make an investment in its infrastructure to achieve operational excellence and profitability for the newly integrated retail network of CAM stores. The Company has the goal of increasing the sales of its online channel by five times in the next four years.

2. ORGANIZATIONAL STRUCTURE AND OPERATION

As shown in Figure 11, The Company's functions are structured into the front line and back line based on the extent of their interaction with external stakeholders. The front line includes store operation and the business-to-business (B2B) division, which is the division that offers customized corporate wear and event uniforms for businesses and organizations. The B2B division has a strategic importance to the company given its contribution to the total sales level.

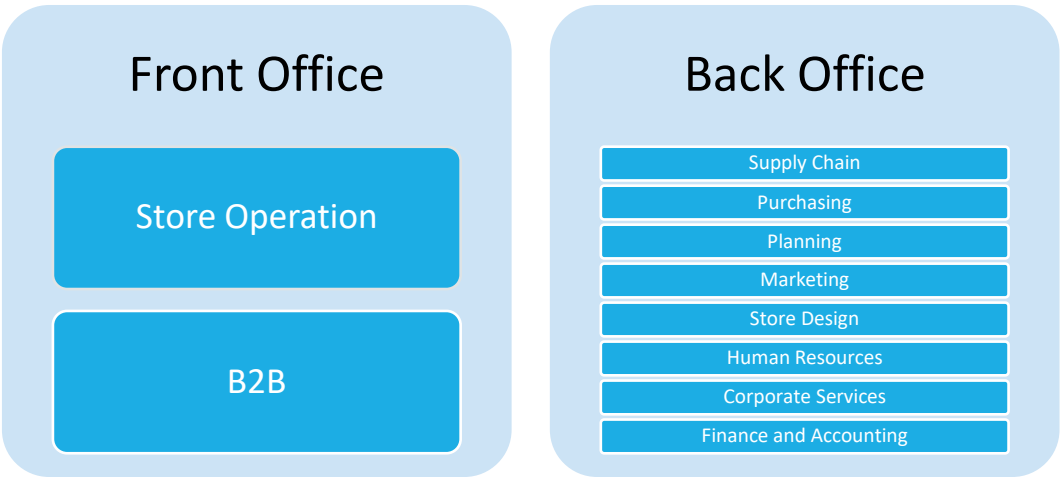


Figure 11: The Company's operational structure

3. SALES AND MARKETING

Sales and marketing activities are those related to its products' sales and promotion, store information and content, store services, and stores' operation in delivering the online sales generated from the online stores.

a) Sales and marketing strategies

The Company varies its product segments based on the characteristics of its customers and function. As a typical fast fashion retailer, The Company offers repeating products, non-repeating products, and seasonal products according to their customers' demand cycle (Figure 12). Its product types include apparel, footwear, and accessories. Its house brands are well recognized by its target customers, while many of its products come from some well-known brands, such as Levi's, Carhartt, Helly Hansen, Sorel, Aggressor, Baffin, CAT, Columbia, Clarks, Kodiak, Merrell, Skechers, Terra, Timberland, Wolverine, and Wrangler.

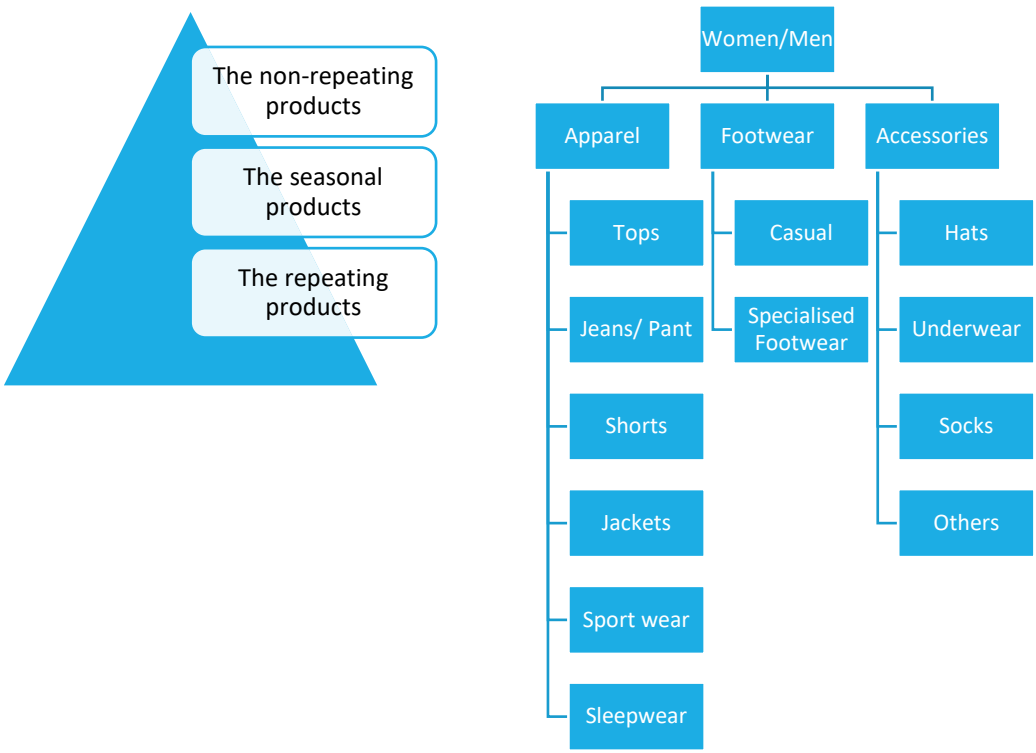


Figure 12: Product segment

Demographically, the women's segment and the men's segment both have similar product categories: footwear, specialized clothing, sportswear and casual wear. The Company is hoping to capture an increasing share of overall casual apparel and casual footwear sales. It recently began rebranding activities, which have led to a better customer experience by redesigning store outlets and offering more variety for its casual apparel and footwear assortments. Other rebranding objectives include increasing customer base through various marketing activities to build store-brand awareness. Marketing activities also include the introduction of new and innovative products.

b) Sales performance for online stores

Sales performance from the online store has been increasingly strong since the inception of the new channel. Its online revenue share in relation to total multi-channel sales has increased marginally in the past few years. The Company's management strongly supports the traditional retail channel as they believe that this is where the target customers prefer to shop. This strong support is further explained by the fact that the customers who contributed a large part of the

market share are those who purchase from the traditional channel. These customers are in the age range between 35 to 50-year-old, and the Company's marketing insight shows that this age group has less motivation to shift from the current shopping channel to the new one. They are less Internet savvy and subsequently find the traditional channel more friendly and familiar.

Recently, strong growth in online sales has encouraged more and more participation of traditional channel retailers. These new players have converted themselves to multi-channel retailers. The stiffer competition will leave behind those retailers who are slow in adapting themselves and capitalizing on the popular trend. The Company has realized the need to invest in the new platform of online sales to be more competitive in the next five years.

Based on the online sales growth rate of the apparel sector, The Company's multi-channel goal is to improve customer satisfaction and increase service level by enhancing their online shopping experience. The business is going through the process of improving its e-commerce offering and fulfillment with three main objectives. First, they are working on enhancing the online stores' product offering to increase service level, as currently only 66% of the SKUs at the physical store are offered online. In the new and improved online store, more SKUs are online. Second, they are in the process of updating the old Point of Sales (POS) and replacing the catalog interface of its website with a newer interface. Thirdly, they are trying to increase sales revenue while enhancing profit margin for online sales.

c) Supply chain and distribution operation

This section examines The Company's Supply Chain System and describes the current information flow and product flow. The Supply Chain function has five different operational teams: DC Operations, Domestic Transportation, Import, Material Management and Supply Chain Improvement. The Front Office's Store Operation team serve both store operations and online order fulfillment.

The Company outsources its non-core supply chain activities to focus on the critical areas of competitive advantages. Most products are outsourced to suppliers in Cambodia, China, Bangladesh, and Vietnam. Hence, its current distribution involves a network of two echelons:

products being shipped from domestic or overseas suppliers will either flow directly to the stores, or to one of two DCs (Figure 13). The two DCs are located in Alberta and Ontario. These facilities use state-of-the-art warehouse management systems, automated conveyor systems, and a light-directed picking system to distribute products to both franchise and corporate stores. The supply chain objectives are to deliver the right products in the right amount and the right price at the right time to the right place (Figure 14).

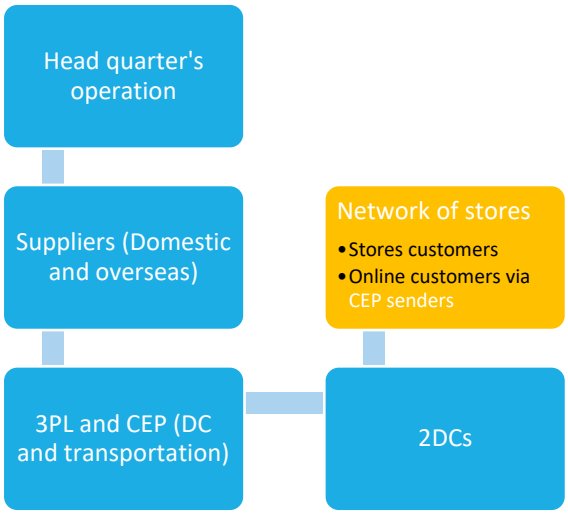


Figure 13: Movement of product flows to customers

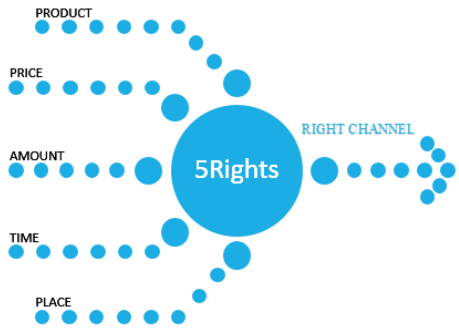


Figure 14: The Company's supply chain objectives

The movement of goods from off-shore suppliers to these two DCs is managed by its supply chain team mostly through the holding company's network of 3PL companies. The first 3PL specializes in transporting product shipments either from the two DCs to its stores or from domestic suppliers directly to its stores. Both DC facilities are leased to The Company by a 3PL lessor. A second 3PL service provider is responsible for domestic transportation services. The Company processes inbound ocean containers from off-shore suppliers through an outsourced Trans Load facility in Vancouver.

Figure 15 shows The Company's value chain, which comprises those activities from the upstream to the downstream across the chain. The Planners' team works in conjunction with the

Designers' team in coming up with new products and designs. These requirements are sent to its network of suppliers for manufacturing. The Buyer and Procurement team manages all aspects of contract management to ensure finished goods are packaged and shipped to various facilities. The Supply Chain Department supervises inbound transportation and logistics. The same team also manages the reception of products from suppliers and inventory management. The sales and demand forecasting and replenishment planning of store orders are allocated to the Demand and Fulfillment team. The Supply Chain Department's Outbound Logistics team manages the outbound logistics and physical replenishment. Marketing and sales activities, and other value-added services such as return management, are shared responsibilities between the Store Operation team and the Marketing team.

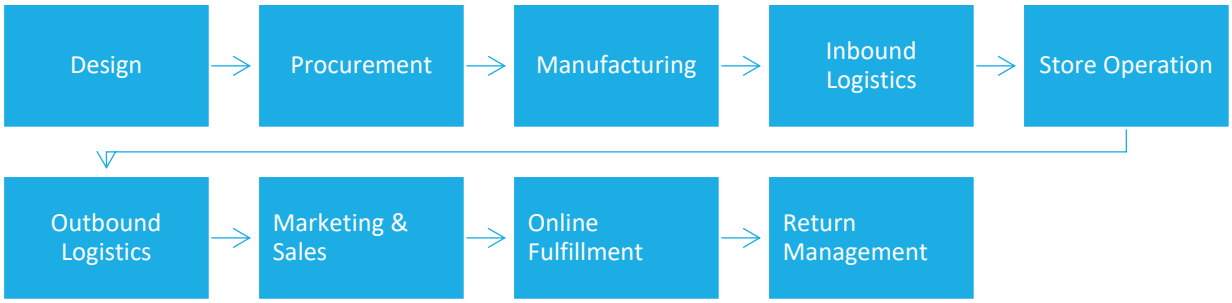


Figure 15: Major activities for The Company's value chain

4. INTEGRATED SUPPLY CHAIN SYSTEM

This section focuses on examining the integrated supply chains system for The Company' e-commerce fulfillment, which is composed of the inventory systems and the ordering system for the online channel.

a) Inventory management and planning

Inventory management and planning consists of three different functions: Merchandise Planning, Business Improvement and Demand and Fulfillment. The standard inventory cycle is 28 days. Safety stocks are calculated by unit needed during the coverage duration. The order quantity is calculated by a number of days of demand requirement plus safety stock. There are four seasons'

launches for the year for basic products. For seasonal items, there are non-repeating offerings which are available for a slightly shorter period before the mark-down.

A replenishment plan is time-phased and the quantity required is calculated using sales forecasts, on-hand inventory, in-transit inventory and incoming orders. The replenishment plan is affected by shipping lead time from the vendor and DCs and by factors affecting order receiving lead time, such as time for order processing, receiving and put away. There are three parameters that determine the quantity for the replenishment plan: safety stock, sales forecasts, and minimum presentation quantity. The last parameters are important as they keep inventory holding cost and mark-down cost low. Minimum presentation quantity is set by unit so that the replenishment plan does not overstock slow-moving items. When there is no forecast for a unit, the parameter is set to cover only the minimum quantity for the one-to-show or the displaying unit and one-to-go or the extra stock in the store. In general, the current practice of carry-over replenishment is deemed to be not as efficient as Just-In-Time replenishment (The Company, 2016).

The Company uses an innovative statistical method to allocate the quantity of stock by size for each store, based on historical demand, sales trends, promotion events and seasonality. This approach allows DCs to split stock between stores based on demand forecast. Inventory replenishment will stop temporarily in two cases: stock-out happens either from vendors or from the two DCs, or products are offered only for a certain period of time to satisfy seasonal demands. In general, the two DCs will stop inventory replenishment permanently if stock-out occurs due to one of these reasons: 1) The Company decides to abandon a style or a product line and thus stops ordering it; 2) vendors producing certain products stop manufacturing for any reasons, such as discontinuing their business and their factory.

Inventory management defines various inventory types based on its availability for channel allocation and physical status. Inventory is organized based on location levels, such as on-hand at the store, the region/DC, the purchasing order (PO), and in-transit, or based on product levels such as SKUs, product style or product family. Inventory salable status (e.g. salable in stores, allocated for the store, allocated for corporate sales, reserved for DC, and damaged) is important for inventory management and allocation among sales channels.

Inventory and replenishment management include a system of two DCs which are designed to provide for its physical store network. The DC in the Western area has a more automated warehousing system than the DC in Ontario. Neither of these is equipped to fulfill online orders.

In general, the online store is highly integrated with the current physical stores. Store shoppers can post reviews and ratings for products that are available online. The sales staff at the store have full access to a network-wide system of product information. Customers can use the online store to see in-store inventory for particular SKUs. Thus, for an item that is out of stock at a particular store, the sales representative can view the inventory of the whole network to find other locations with the desired product.

The integration of channels allows customers to check the inventory before making a visit to a store. Customers can also reserve an item over the phone or the Internet for pick up in store as well as order for delivery to their home. Pricing and promotions are consistent across channels and stores. This consistency ensures that the customers would not have to favor one channel over another for purchases.

b) Order fulfillment for online sales

As mentioned in the previous section, The Company's sales channels are highly integrated. The order fulfillment for online sales is done from stores using the store's inventory and store staff. Figure 16 illustrates the information flow and product flow for this process. It is important to highlight that the last-mile delivery is currently from the stores to the customers. In terms of information flow, the input for online sales demand planning and forecasting consists of historical sales data and future marketing and sales plans. The output of that process is shared among relevant departments for supply planning and procurement. The suppliers are engaged at the end of the previous process for material sourcing and sample manufacturing. Products from the suppliers are sent to The Company's two DCs in Ontario and Alberta. This movement of product is called the inbound transportation. Based on the demand allocation from the central system, merchandise is sent from the two DCs to stores to replenish for both store customers' demand and online customers' demand. This stage of product movement is called the outbound transportation. The individual orders from the customers are pooled into the central processing system and are

processed by the nearest store with available merchandise. The last-mile delivery process from store to customers, which entailed all the necessary steps, will be described right below.

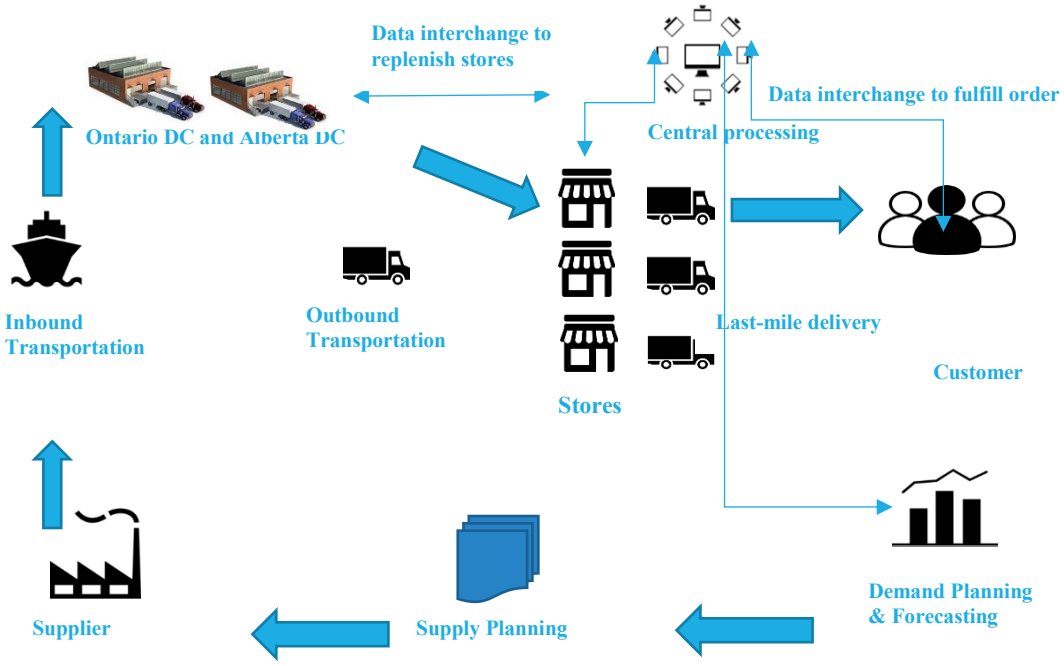


Figure 16: Information and product flow of order fulfillment for online sales

There are four main directions of information flow involved in the online fulfillment process for The Company: 1) order placement; 2) pick-and-pack; 3) shipment; and 4) order return.

Firstly, for the ordering phase, customers place their orders on one of The Company's websites based on the available inventory levels on the network. The new online order is routed to a centrally-pooled inventory management system called Quick Search. Once payment is made, fulfillment is decided among the stores in the company's network.

Quick Search allows orders from online stores to be accepted for fulfillment by a physical store. Each store decides whether to accept the order according to two factors: the match between the inventory availability and the product on demand at the web store, and the store's capability to fulfill that product. Stores view orders, review product availability and confirm stock on hand before accepting or rejecting orders.

Once order status is opened and deliveries are scheduled, store staff will pick and pack the accepted order. The order confirmation is transmitted to the customer at the end of this stage. The store will fulfill the accepted order, and the fulfilling store records the sales revenue.

Next, shipment to customers is conducted by a 3PL service provider from The Company's shipping account. The Company gets the tracking number from the shipper's system and sends a shipment confirmation email to the shopper. A rejected order from the store is deemed unfulfilled and stays online until the 15th day before finally being rejected by the system. Orders that contain multiple items could be split in the case that not all of the items are available at one store. The customers would be notified accordingly in each stages of the order fulfillment.

Finally, online returns to The Company are designed for flexibility. The items can be returned directly to any store near the customers' location or can be sent back to any store using a parcel courier service.

Figure 17 below shows the order flow for the online sales fulfillment for SFS process.

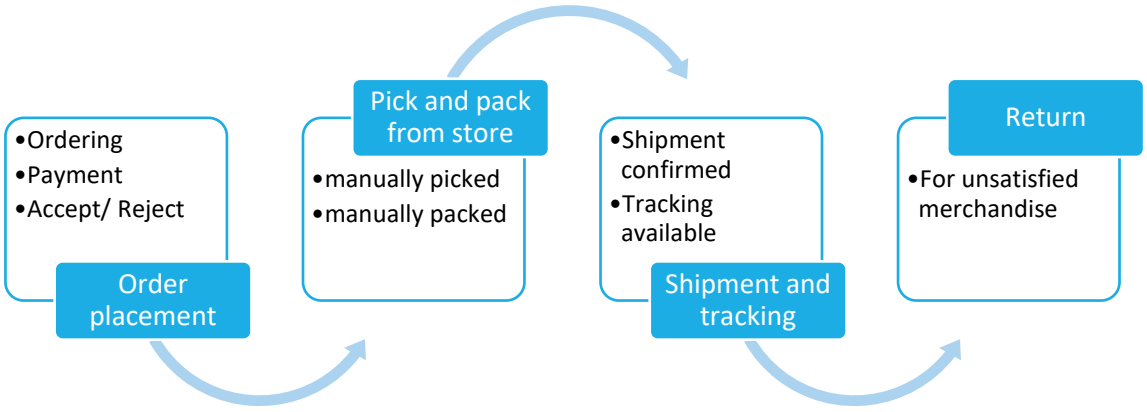


Figure 17: Fulfillment process to customers

The order processing system has proven to be effective and suitable for the current scale of the online sales revenue. The SFS model gives stores a fulfillment window of 4 to 8 hours before the order is rolled to the next store's system. Quick Search optimizes the process by selecting the store closest to the customer's location to be the fulfilling store. Most shipments will, therefore, be local and have better lead time compared to shipments from a central stocking and shipping

point. Most importantly, the current strategy gives the company the time it needs to evaluate the most cost effective approach at the desired service level to find the best alternative distribution network design for integrated sales across the channel.

However, SFS also means that the location of the fulfilling store is not fixed. These dynamic origin points make determining shipping destination a complex task. In using certain CEP shipping services, the exact rate code used to calculate the exact shipping fee from each store is not fixed or pre-determined in advance. The confirmation of the delivery time also varies based on the origin store and the destination of the shipment. It is difficult to have 100% accuracy of shipping time as the system promises delivery days based on the central inventory system while the delivery is actually done from one of its stores.

In brief, the merchandise is pooled out of the whole system's inventory from individual stores to fulfill an order. The company can utilize its inventory pool and reduce the integrated inventory in the system even though the shipping cost might be higher. However, a customer will receive a delivery faster if 1) the store is nearby and 2) the company has a centralized inventory and centralized fulfillment center that has a faster processing time. If the customer decides to return the order, he can send it back by post to any store or he can directly go to the nearest store where he can return it and at the same time browse for another item.

IV. ANALYSIS OF EXISTING AND ALTERNATIVE ONLINE FULFILLMENT OPERATIONS

As discussed in Section II, the literature review proposes to examine various key factors concerning The Company's online fulfillment design. Additionally, Section II also suggests the examination of relevant data. This helps to examine the cost-profit issues as well as the service issues created by the current distribution network, online fulfillment design, and shipping service management. This section presents the analyses of these key elements across The Company's online order fulfillment process.

A. Analysis of existing online fulfillment operations

1. DATA DESCRIPTION

The Canadian apparel industry's sales value and The Company's annual sales revenue from 2013 to 2015 are collected to analyze trends and to project future sales. The detailed analysis uses monthly sales data for 2015 and 2016. The study is based on online sales data from July 2015, December 2015 and March 2016. The data sets in the analysis are presented in Table 10. These variables consist of order data, shipment data, fulfillment cost data, and performance data for all online sales transactions shipped from all stores to customers in all provinces in Canada. Due to confidentiality, some data which would indicate the identity of the retailer have been changed so that identifying The Company is not possible.

ORDER DATA	SHIPMENT DATA	FULFILLMENT COST DATA	PERFORMANCE DATA
1. Order number 2. Order value 3. Quantities ordered 4. SKUs per order 5. Order date 6-7. Customer's geographic data (Postal code, city, province)	8. Shipment value 9. Quantities shipped 10. SKUs shipped per order 11. Ship date 12-13. Fulfillment center's geographic data (Postal code, city, province) 14. Number of shipments per order	15. Handling cost per shipment 16. Total handling cost per order 17. Shipping cost per shipment 18. Total shipping cost per order 19. Shipping charge to the customer	**Financial performance data** 20. Gross profit margin for store sales based on the percentage of Cost of Goods sold (COGS) 21. Gross profit per order at store 22. Gross online profit **CPE services performance data** 23. Pick-and-pack time 24. Shipping time

Table 10: Data by category

The data set with all variables and their relationship is demonstrated in Table 11

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Order #	Ordered value	QTY ordered	SKUs ordered	Order date	Customer PC	Customer Province	Shipment value	QTY shipped	QTY SKUs shipped	Ship date	Store number	Store Province	QTY shipment	Handling cost	Total handling cost	Shipping cost (SC)	Total SC	Shipping charge-99$	Store profit margin	Gross profit at store	Online profit	Pick& pack time (days)	Shipping time (days)
1977	$49.8	2	2	2015-07-01	T6X	AB	$49.8	2	2	2015-07-02	832	AB	1	$3.5	$3.5	$22.6	$22.6	$8.5	48%	$23.9	$6.3	1	1
															(15)x (14)		(17)x (14)			(20)x (2)	(21)-(16)-(18)+(19)	(11)-(5)	

Table 11: All variables and their relationship in calculating performance indicators in SFS using Purolator's Express shipping service

A detailed description of all variables in the fulfillment cost related data and the performance related data is as follow:

a) Order data

1. Order number: Order ID to identify the order. The example ID is # 1977.

2. Order value: Total value of the order from the customer. The example order value is $49.8.

3. Quantities ordered: Total number of products ordered in the same order ID. In this example, there are two items being ordered.

4. Number of SKUs per order: Total number SKUs per order. The two items ordered are from two different SKUs.

5. Order date: The date the order was accepted. The example shows 2015-07-01.

6-7. Customer's geographic data (Postal code, city, province): All order data related to the customer's information. The example shows a postal code starting from T6X from Alberta (AB).

b) Shipment data

8. Shipment value: Total value of all shipments in an order. The order in the example is delivered fully which shows an equal shipment value and order value of $49.8.

9. Quantities shipped: Total quantities of products shipped from all shipment in an order. As the order in the example is delivered fully which shows an equal quantity for both shipment and order.

10. Number SKUs shipped: from all shipments in an order. Similarly, number of SKUs shipped are the same as those in the order.

11. Ship date: The date the last item in the order is shipped. The example shows 2015-07-02.

12-13. Fulfillment center's geographic data (Postal code, city, province): All order data related to the FC's information. The example shows Store number: 832 from Alberta (AB).

14. Number of shipments per order. This order is shipped in one time.

c) Fulfillment cost related data

15. Handling cost per shipment: calculated using labor cost per hour by store staff per shipment. The example shows $3.5 for one shipment

16. Total handling cost per order: total handling cost of all shipments in an order. As the total handling cost depends on the number of shipment, its total cost in the example is equal the handling cost for one shipment.

17. Shipping cost per shipment: a flat-rate charge of $22.6 per shipment from any origin to any destination in Canada.

18. Total shipping cost per order: calculated based on a total number of shipments per order. The order in the example ships all items in one shipment makes its total shipping cost per order equal with shipping cost per shipment.

19. Shipping charge to the customer: Table 12 presents shipping schedule change by the monthly sales data. Before March 2016, The Company set a flat-rate shipping charge of $8.50 to any online order for home delivery service. In evaluating its cost structure and profitability, The Company has just changed its shipping charge policy to a conditional free shipping. This change allows the customers to be entitled to free shipping if their order value meets the predetermined value of $70. In that case, all shipping cost will be absorbed by The Company. The Company expects that this change will increase their profit per order as this policy requires shoppers to increase the number of individual items or the value of their orders to qualify for the threshold.

SHIPPING CHARGE SCHEDULE BY MONTH		
Jul 2015	Dec 2015	Mar 2016
Shipping charge: $8.5 per order		Free shipping for order value >$70
Flat-rate shipping charge		
		Conditional free shipping

Table 12: Timeline for shipping charge schedule change to customers

d) Performance data

Financial performance data

20. Gross profit margin for store sales: 48%. It is used to calculate the final profit for the product at store based on the percentage of Cost of Goods Sold (COGS) on total sales revenue.

21. Gross profit per order at the store: calculated by applying a ratio of store's gross profit margin to online sales revenue.

$$Store\ profit = Sale\ revenue\ x\ Store's\ gross\ profit\ margin$$

The example shows a gross profit of $23.9 which is the result of (20) x (2) or 48% x $49.8.

22. Gross online profit: based on the store's profit, online order's handling cost and shipping charges by CEP providers. When the retailer applies a shipping charge to customers for delivery

services, this charge is an additional revenue to be added back to the online sales profit. When conditional free shipping is applied, and the customers meet the threshold, this revenue is zero, in exchange for higher profit from bigger order value.

$$Online\ order's\ profit\ =\ Store\ profit -\ handling\ cost - Shipping\ charge\ by\ CEP\ provider +\ Shipping\ charge\ to\ customers$$

The online order profit $6.3 (22) is calculated by extracting the fulfillment cost such as the handling cost (16), the shipping charge by CEP provider (18), and by adding back the shipping charge to customers (19) from the gross profit per order (21) in the case it is sold at the store.

CEP services performance data

23. Pick-and-pack time: the time between an order being placed and the latest shipment date. The example shows one day

24. Shipping time: the time elapsed between the order being shipped and the order receipt at the customer's address. It also takes one day for shipping the example order.

2. ORDER PROFILING

The orders will be profiled based on 1) order value and shipment value; 2) month of order; 3) geography and 4) order value density and product density.

a) Order profiling by order value and shipment value

This section explores the data in order to profile all orders and shipments based on all available variables (Table 13) for a comprehensive understanding of the retailer's online sales characteristics. The relationship of each variable with profitability is the main interest of the data exploration.

The summary statistics in Table 13 and the plots in Figure 18 and Figure 19 all indicate that the distribution of all order values and all shipment values in the three sample months are almost identical. The distribution analysis shows that both order value and shipment value have similar means and medians, which are around $96 and $77 respectively. Both distributions, however, are asymmetrical over the mean and thus their values are not normally distributed. At a skewness of 5.9, both distributions skew toward the left side of the bell curve with a higher concentration around the mean.

Variable	Mean	Std Dev	Minimum	Maximum	Median	Skewness
Ordered value ($)	95.92	75.38	4.99	2879.38	77.56	5.89
Shipped value by order ($)	95.81	75.20	4.99	2879.38	77.34	5.85

Table 13: Summary Statistics - Order value and shipment value by order

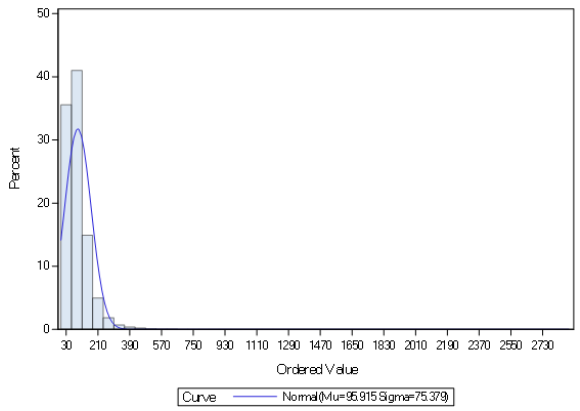


Figure 18: Distribution of order value

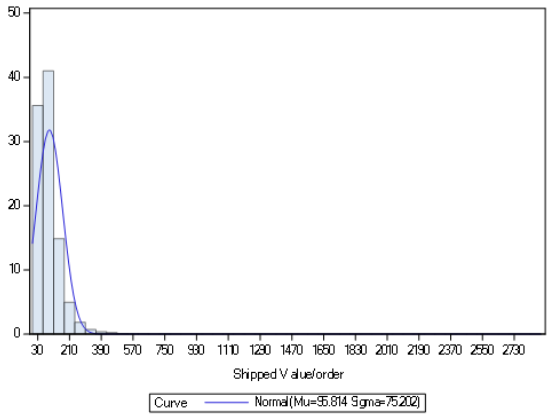


Figure 19: Distribution of shipped value by order

Figure 20 categorizes all orders by three related variables: quantity ordered, quantity shipped, and an average number of shipments against each order value range. The x-axis shows the value of these three variable by the different order value ranges: below $25, between $25 and $50, between $51 and $100, between $101 and $150, between $151 and $200, between $201 and $1,000, and between $1,000 and $4,000. As in Figure 18 and Figure 19, the order and the shipment, percentage of the quantity ordered, and quantity shipped per total quantities ordered are almost identical within each order value range. For all orders, most of the order values are between $51 and $100 (37.41%). Those that are between $101 and $150 (23.09%), between $201 and $1,000 (14.14%), between $25 and $50 (12.36%), and between $151 and $200 (10.81%) are the main ranges being ordered. Those that are below $25 (1.81%), and between $1,000 and $4,000 (0.37%) are the minor ranges. The average number of shipments per order increases with the order value. For example, orders below $25 have an average number of shipments of 1.032 while those between $25 and $50 are split into an average of 1.106 shipments. Orders between $51 and $100, between $101 and $150, between $151 and $200, between $201 and $1,000, between $1,000 and $4,000 have an average number of shipments of 1.238, 1.473, 1.675, 2.432, and 6.750 respectively.

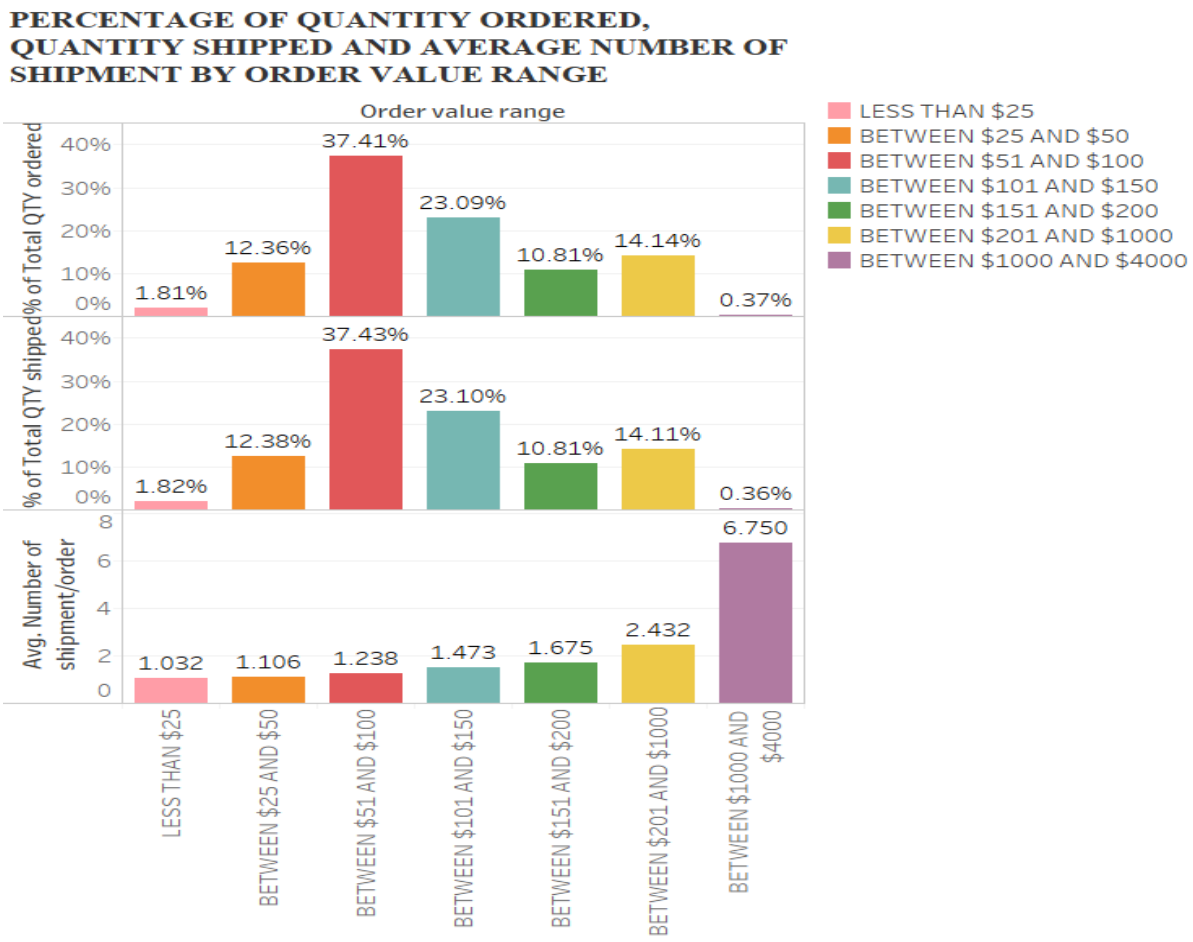


Figure 20: Percentage of quantity ordered, quantity shipped and average number of shipments by order value range

b) Order profiling by month

The histograms in Figure 21 to Figure 23 provide an overview of the density distribution of the order values. The summary statistics in Table 14 and the plots in all three Figures indicate that the distribution of all order values in each of these months are not normally distributed. Even though they are all concentrated around the mean, their mean values are not similar. Figure 21 and Figure 22 and show the order value distribution for those orders that pay flat-rate SC while Figure 23 shows those that have a conditional free shipping.

In both Figure 21 and Figure 22, the histograms skew toward the left and are concentrated in the ranges of $80 and $90 respectively. For those orders placed after the free shipping threshold policy was launched, the mean has been shifted significantly compared to those in the two previous samples.

MONTH	Mean	Std Dev	Minimum	Maximum	Median	Skewness
Jul'15	82.81	69.92	7.49	1,769.89	64.52	6.06
Dec'15	94.91	70.95	4.99	2,061.03	75.98	4.84
Mar'16	106.14	90.61	5.99	2,879.38	95.19	7.37

Table 14: Summary Statistics - Order value distribution by month

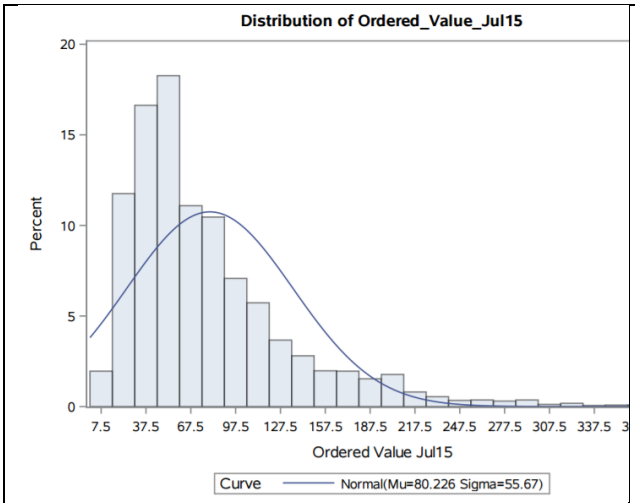


Figure 21: Distribution of order value- Jul'15

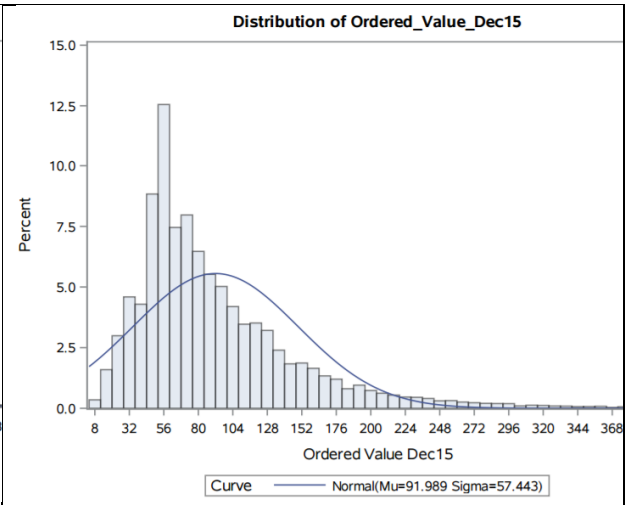


Figure 22: Distribution of order value- Dec'15

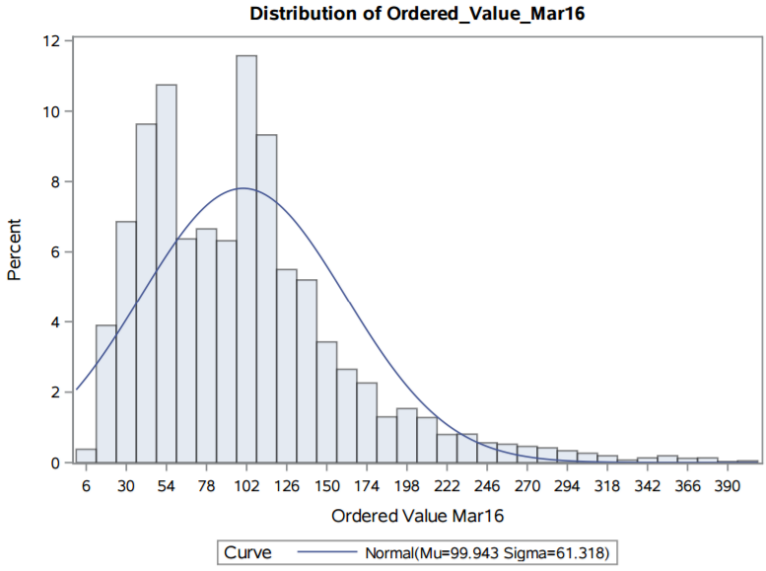


Figure 23: Distribution of order value- Mar'16

Figure 24 demonstrates the effect of free shipping on the total quantity of orders. The number of orders for each day is broken down by the order date. The height of the vertical line shows the total quantity of orders. It is likely that holiday and promotional effects are shown for

online sales volume patterns based on the date and month ordered. A large variance in demand between the month and the average month is due to the sharp increase of additional demand in December. This increase in the number of orders is explained by the free shipping event in the first and last weeks of December. The peak demand of December is approximately five times more than that of the non-peak period in July. Free shipping events in December stimulate demand, which forms many peaks around the promotional period.

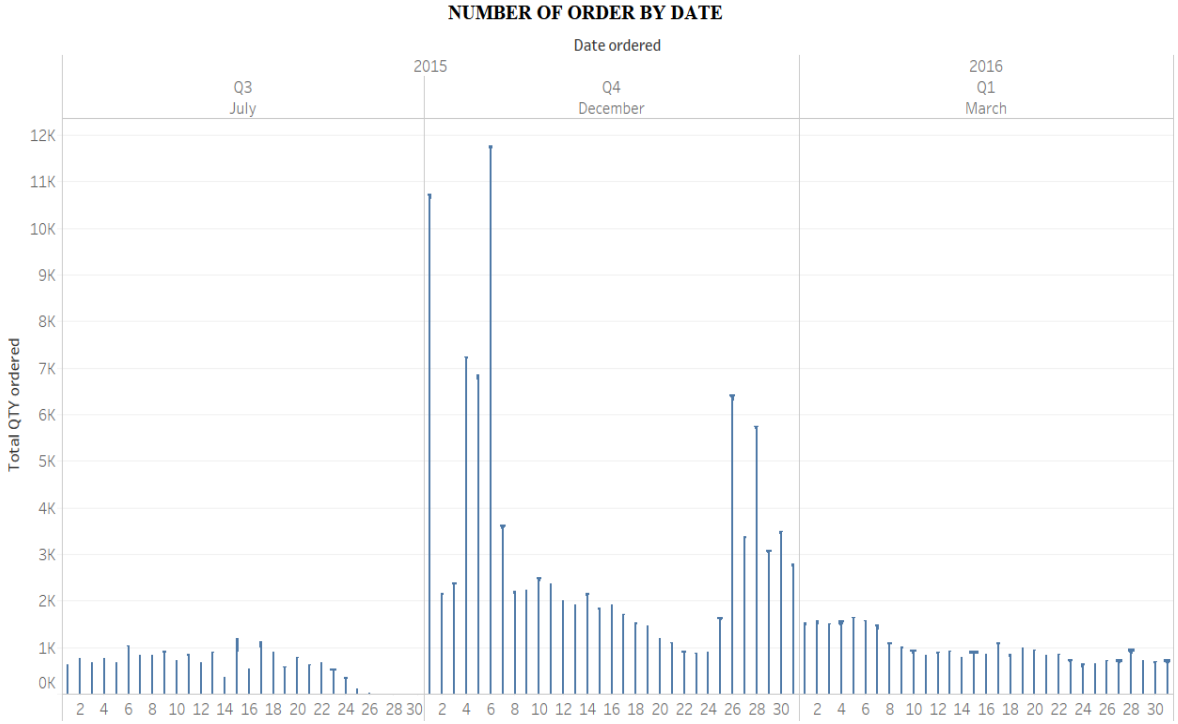
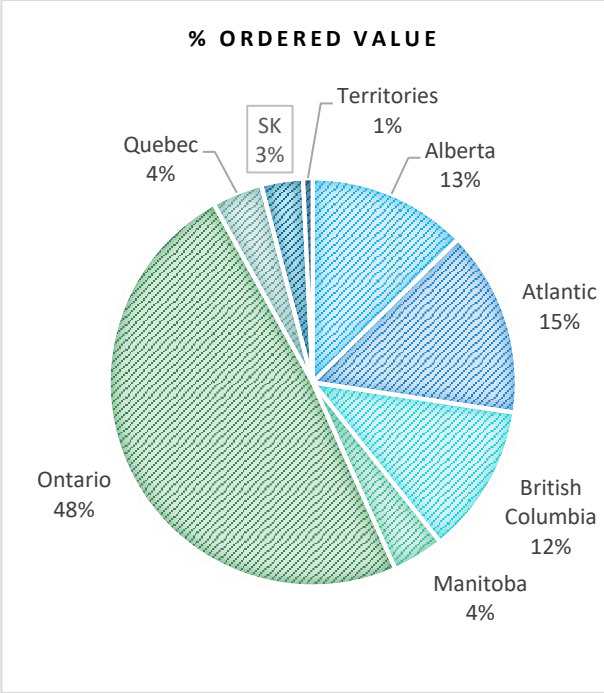


Figure 24: Number of orders by date

c) Order profiling geography

Regarding the order value and the number of orders by province, Figure 25 and Figure 26 show the relationship between sales values, number of orders, and customers' location. There is a strong concentration of customer orders from Ontario. Orders delivered to Ontario account for 49% of the total number of online orders fulfilled and 48% of all online sales value. The total sales value of Alberta shows that there is a slightly higher density of order value in this region compared to other regions. A total sales value of 13% in this region (Figure 25) comes from only 12% of orders (Figure 28). The rest of the provinces and territories have more or less the same share.



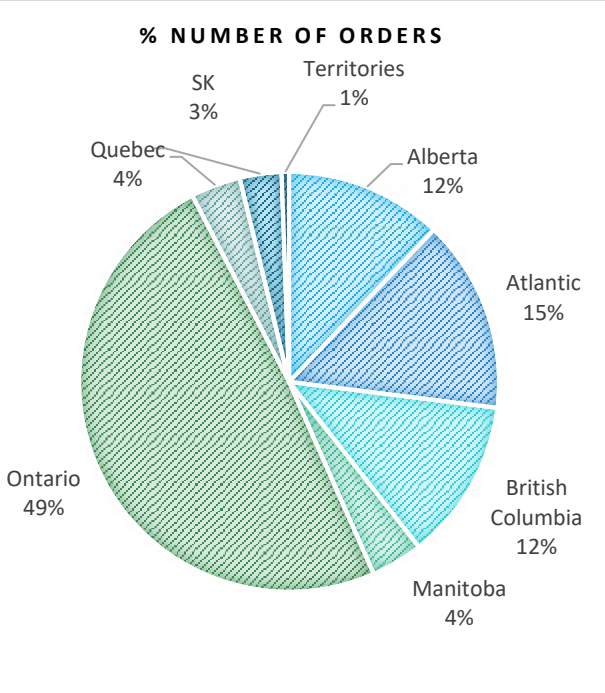


Figure 25: Customer by region and sales value

Figure 26: Customer by region and number of orders

Figure 27 shows the dynamics of the percentage of total quantities of orders being fulfilled based on the origins and destinations of the orders. The horizontal bars in the y-axis show the proportion of number of orders which are fulfilled by stores by provinces. The customer provinces are shown in the upper y-axis. The cross-demand fulfillment data gives more insight into the optimal allocation of inventory based on stores' demand and online demand than the aggregate fulfillment data. For example, the surplus inventory in store suggests that store sales in those regions are not fast enough.

Stores in AB fulfill nearly half of orders originating from the province of Alberta (45.6%). The rest of the orders fulfilled by stores in AB are for customers in ON (18.9%), BC (16.5%), the neighboring provinces (MB, SK) and all Territories (12.3%) and even customers in Atlantic provinces (5.4%) and QC (1.2%).

Stores in the Atlantic provinces fulfill almost 67.6% of the region's demand while the rest of orders are fulfilled to customers in ON (19.7%), the Western provinces (7.86%), and QC (3.0%).

Nearly 63% of orders fulfilled by all stores in BC are orders originating in-province, and the rest of fulfillment of these stores is for customers in ON (14.1%), AB (13.2%), MB, SK, and all Territories (5.6%), and the Atlantic provinces (3.4%).

Stores in MB, SK, and all Territories fulfill 43.6% of in-province demand and send surplus inventory mainly to ON (18.5%), AB (10.3%), BC (8.8%), and Atlantic (7.4%).

Stores in ON fulfill 79.9% of in-province demand, and the rest of their fulfillment are mainly to the Atlantic provinces (5.5%), AB (4.8%), BC (4.2%), MB, SK, all Territories (3.5%), and QC (2%).

For stores in QC, only 12% of orders originated in-province. The rest of the fulfillment of these stores is for customers in ON (50.7%), the Atlantic provinces (21.6%), AB (6.4%), BC (5.4%), MB, SK, and all Territories (3.9%). This fact suggests that stores in QC have more surplus inventory to fulfill online sales than other provinces. The cross-demand fulfillment helps to increase fill rate and also increase satisfaction from the customers who might be impacted if stock-outs occur.

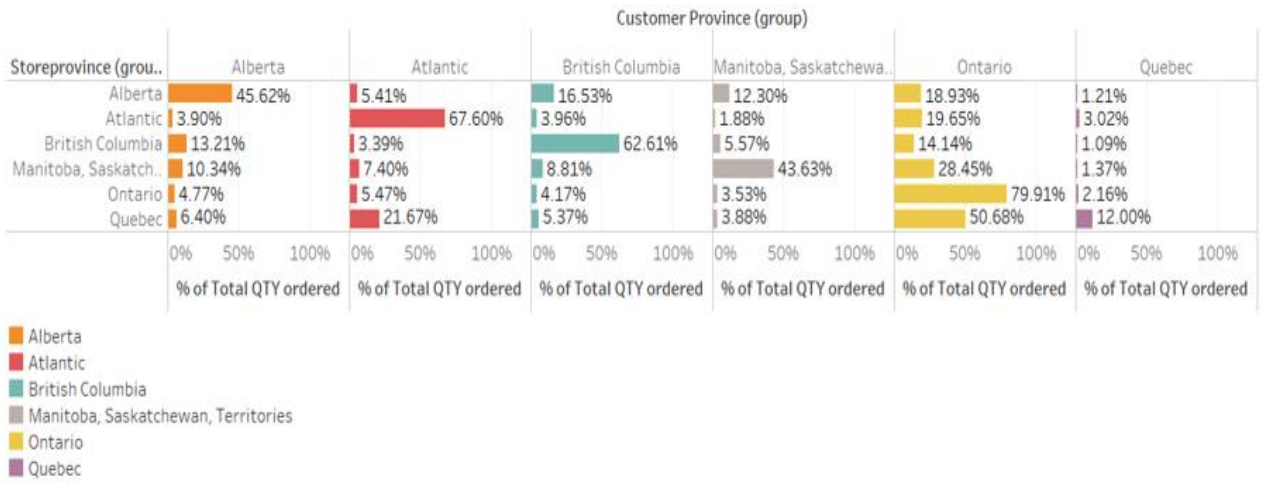


Figure 27: Percentage of number of order by customer and by store's province

There might be room to optimize inventory allocation for those stores. The stores that currently fulfill regional and national online sales are those that are overstocked relative to the demand of local customers. Cross-fulfillment allows the overstocked inventory to be used as buffer stock for online sales. However, there are inventory carrying costs in addition to national

shipping costs incurred in sending this stock from faraway locations to the other side of the country. The statistics in section IV.A.3 - Financial performance will demonstrate the relationship between profitability and the geography of fulfillment stores.

d) Order profiling by value density and product density

Figure 28 shows the increase of order value density from July 2015 to December 2015 and March 2016. In general, the number of small orders valued less than $50 per order decreased sharply from July (37%) to December (21%). Interestingly, the number of orders in this value range increased in March 2016 (24%). This finding is interesting because, with free shipping events, it would be expected that order value density in December might decrease compared to July, as customers do not have to order higher values to obtain free shipping. The promotional price and free shipping offer might affect both the number of orders and the average order density for December. One possible explanation for the increase in December is the higher retail value for winter season products.

Figure 28 also plots the percentage of orders by different order value range by month. An increase in the number of orders of medium to large size ($100 and up) is seen in March 2016; the percentage of this order value range in March 2016 is 42%, compared to 75% in July 2015 and 33% in December 2015. This finding has some profound implications for the impact of conditional free shipping on order incidence across the months being studied.

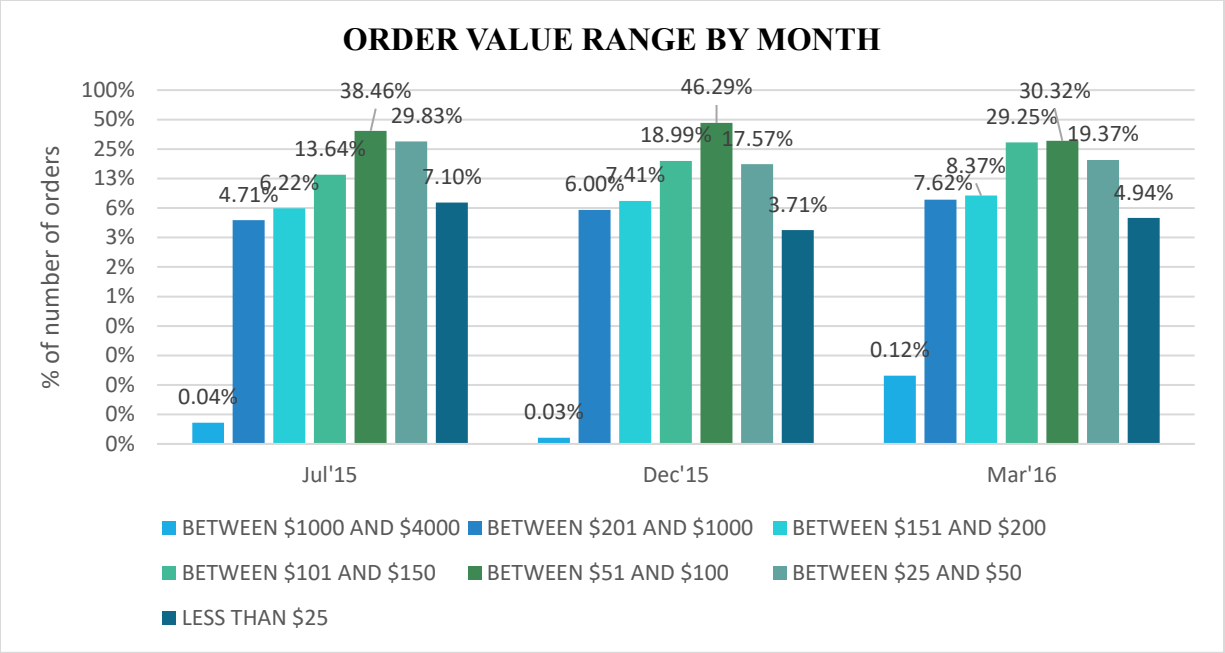


Figure 28: Order value density distribution by month

Product density refers to the number of products per order. The average number of products ordered in each transaction is the key indicator with which to calculate the product density by order and by month. Orders from different months across all regions show little difference in terms of product density.

In Figure 29, we see that the product density per order for July 2015 is the highest, despite this month also having the lowest order value density, as shown in Table 15 below. This fact means that an average order in July has more items of lower retail value than orders in December 2015 or March 2016. However, there are no consistent trends of product density that show the value of the order going up for every month; the product density by month goes up and down randomly. It is thus hard to draw any conclusions from this observation.

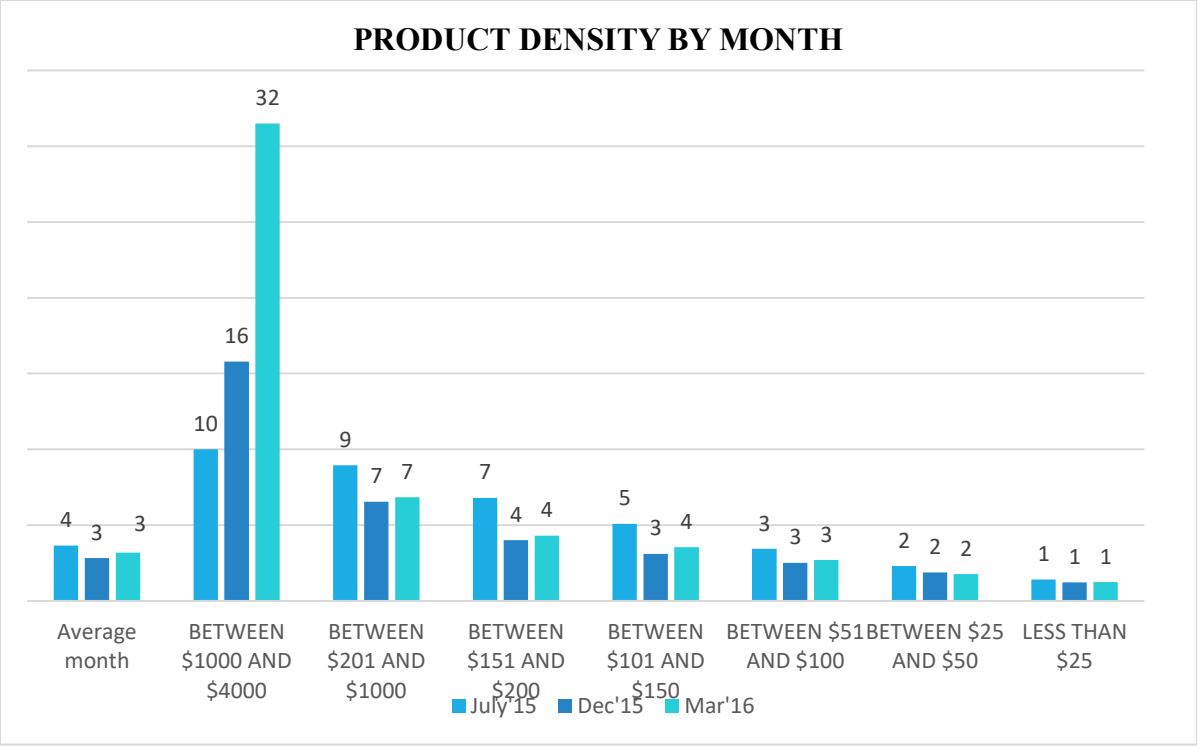


Figure 29: Product density by month

Table 15 shows that despite having a higher than average number of items per order in the month of July 2015, as well as a higher quantity ordered, the order value was generally lower than average. In contrast, the average order value in March 2016 was higher than average despite having a lower number of items per order.

MONTH	AVE. NUMBER OF SKU/ORDER	AVE. QTY ORDERED	AVE. ORDERED VALUE
JULY'15	2.93	3.43	$93.54
DEC'15	2.53	2.74	$102.52
MAR'16	2.49	2.98	$119.20
TOTAL	2.55	2.84	$104.79

Table 15: SKU per order, quantities ordered, and ordered Value

3. FINANCIAL PERFORMANCE

The summary statistics in Table 16 and the histogram in Figure 30 all indicate that the distribution profit value in all three sample months is close to normal distribution. The distribution analysis shows that their median of $16.74 is close to the mean of $22.15. There are more profit values concentrated in the middle of the bell curve, with a higher concentration toward the left side

of the mean. Table 17 shows the profitability probability of order value in the sample by the range and by month. In general, the average sample shows that the higher the order value, the higher the probability of having a profitable order. At any value below $25, the order in the sample months does not yield any profit. For the bracket between $25 and $50, the profit increases sharply to 63%. The proportion is 88% for the bracket between $51 and $100, and 90% for orders above $100.

Variable	Mean	Std Dev	Minimum	Maximum	Median	Skewness
SFS profit	$22.15	$38.62	-$240.90	$1,277.88	$16.74	3.62

Table 16: Summary statistics using Purolator's Express - SFS profit distribution

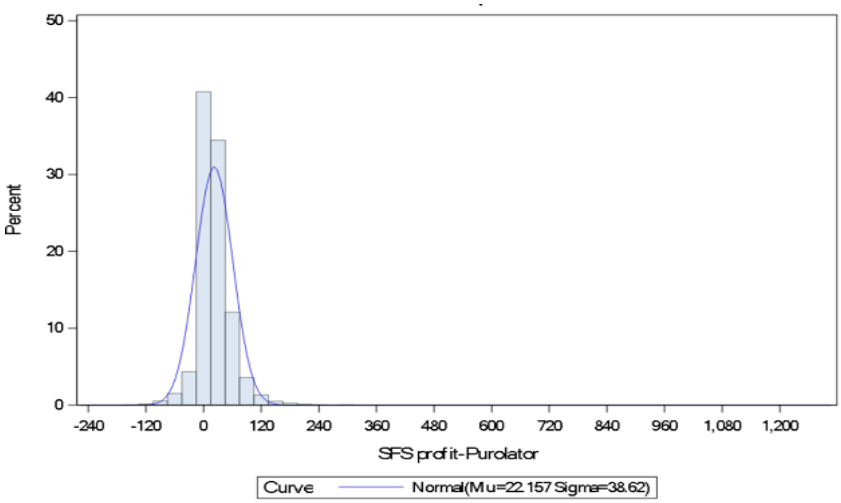


Figure 30: Distribution of SFS profit by Purolator's Express

Month	Jul'15	Dec'15	Mar'16	Ave. sample
ABOVE $1000	100%	100%	100%	100%
BETWEEN $201 AND $1000	77%	94%	91%	92%
BETWEEN $151 AND $200	78%	93%	87%	91%
BETWEEN $101 AND $150	75%	94%	83%	90%
BETWEEN $51 AND $100	82%	91%	78%	88%
BETWEEN $25 AND $50	56%	66%	59%	63%
LESS THAN $25	0%	0%	0%	0%

Table 17: Profitability probability of orders by Purolator's Express shipping service- SFS by month

a) Order profitability variabilities by month

Figure 31 plots the basic components for calculating the gross profit of an average order in the three-month sample: the average ordered value, the cost of goods sold (COGS), the average handling cost and shipping cost (HC&SC), and the average shipping charge. The yellow bar in Figure 31 shows the cost components that determine the final gross profit.

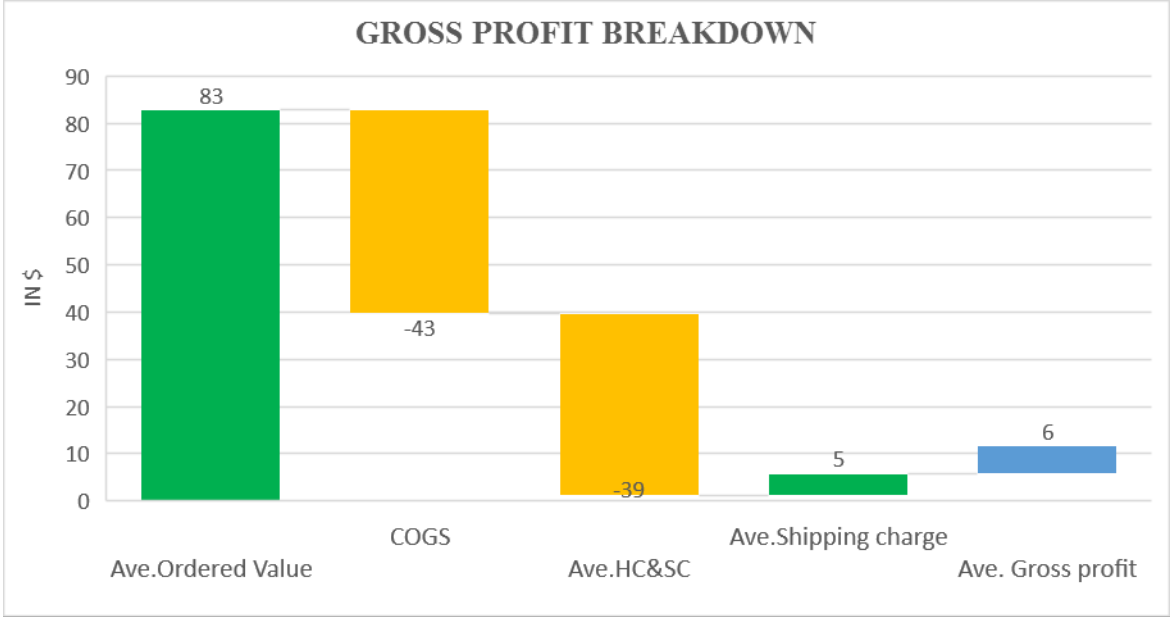


Figure 31: Gross profit breakdown by online fulfillment cost

Table 18 shows the average value of the gross profit by month. There are some major differences between the average order value and profit value during the period of flat-rate shipping charge and during the period of post-flat-rate shipping. The increase in order value density contributes to the gross profit per average order. After the free shipping threshold policy launched in March 2016, an off-peak month, there is an increase of 28% from $83 (July 2015) to $106 (March 2016). The profitability goes up by 86% for an average order in the same comparison, from $11 (July 2015) to $20 (March 2016).

MONTH	AVE. ORDERED VALUE ($)	COST OF GOODS SOLD (COGS) ($)	AVE. HC&SC ($)	AVE. SHIPPING CHARGE ($)	AVE. GROSS PROFIT ($)
JULY'15	82.8	39.7	38.6	4.7	10.9
DEC'15	94.9	45.6	31.6	4.3	24.3
MAR'16	106.1	50.9	41.2	3.3	20.3
TOTAL	95.9	46.0	34.2	4.1	22.2

Table 18: Gross profit breakdown by month

As time series data are limited, the increased profit effect on the sales volume of the times is not clear. However, the online sales value of March, the month when the conditional free shipping started to apply, was $106.10 or 28% higher than the online sales value of July, which was $82.8. This higher order value density's effect on profitability explains why online retailers favor free shipping thresholds over fixed shipping charges. In comparing the order density of March 2016 and that of July 2015 and December 2015, it is evident that the highest density and profit per average order are achieved after the free shipping threshold policy launched. Figure 32 shows the Pearson Correlation Coefficients between value density and profit per order. In the range of orders analyzed during the pre-conditional free shipping and the month applying conditional free shipping, the order value is positively correlated with profit per order: the higher the value density per order, the greater the total profit achieved by both shipping charge policies.

PEARSON CORRELATION COEFFICIENTS	
N = 35059	N = 15134
Order value applying flat-rate shipping charge	Order value applying conditional free shipping charge
SFS profit - flat-rate shipping charge months: 0.79960	SFS profit - conditional free shipping month: 0.71255

Figure 32: Pearson Correlation Coefficients between order value and profit for flat-rate and conditional free shipping

Figure 34 shows that there is a stronger correlation between order value and non-negative profit with flat-rate shipping than with conditional free shipping. In the case of orders placed before free shipping (Figure 33), there are slightly fewer outliers, which leads to the higher correlation coefficient between the two variables. When the customer pays the shipping costs instead of the retailer, the correlation between order value and profit is necessarily going to be a little bit stronger.

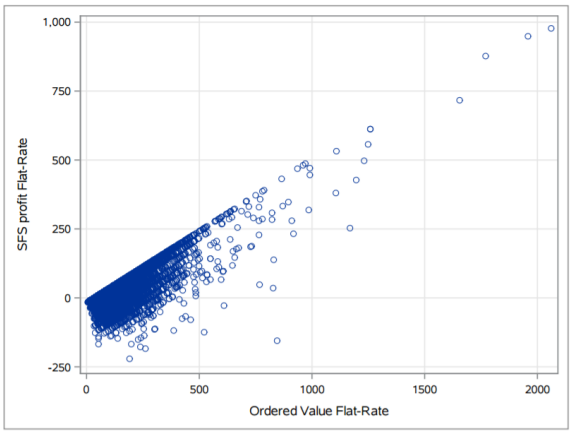


Figure 33: Order value and profit - flat rate shipping charge

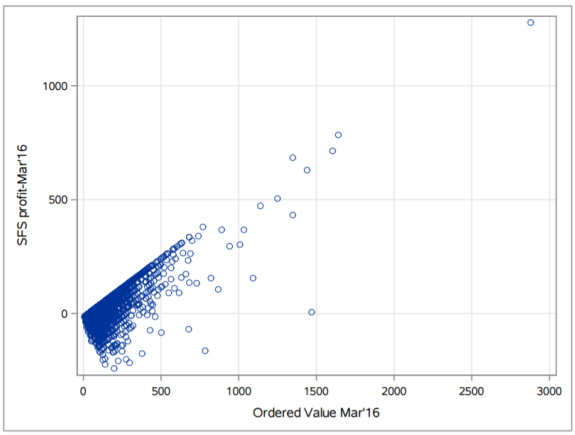


Figure 34: Order value and profit - conditional free shipping charge

In general, it is demonstrated that The Company's profitability depends on the order value density. The higher the order density, the lower the shipping cost which must be absorbed by The Company is. According to the data, there are some factors that contributed to the increase of order value and reduction of shipping expenses, and thus increase profit: free shipping promotions, as demonstrated in sales data of December 2015, and conditional free shipping applied from March 2016. With the new SC, the company seems to lose part of its shipping revenue from those orders that meet the shipping threshold. However, this lost revenue is offset by the larger net profit from higher order value density.

4. FULFILLMENT SERVICE PERFORMANCE

There are two elements in the fulfillment process which determine service performance: the fill rate and the fulfillment time.

a) General fill rate

The order fill rate is calculated from two variables: the total quantity (QTY) ordered and total quantity shipped. Table 19 shows the fill rate and the absolute number of units that are not being fulfilled across months. The absolute number of unfulfilled units in December 2015 is not significantly higher than that in July 2015 or lower than that of March 2016. In contrast to the poor fill rate phenomenon during the holiday period for most online retailers, the December fill rate out-performs those of March and July.

The number of unfulfilled orders increases during the holiday season and in March when the order value density increases to meet the newly established free shipping threshold. Most unfulfilled items are seen from multi-item orders, which are also shipped from various stores and at various times due to the stock unavailability at individual stores, potentially resulting in some items in the order being rejected after an order has been accepted. Thus, the unfulfilled rate might be improved if inventory accuracy is higher than it is.

MONTH	FILL RATE	UNFULFILLED UNITS FROM MULTI-ITEM ORDERS
JULY'15	99.8%	30
DEC'15	99.9%	136
MAR'16	99.5%	156
TOTAL	99.8%	322

Table 19: Fill rate and unfulfilled units by month

Table 20 presents the number of shipments needed to fulfill orders and the average unfilled items per order. These variables are filtered by the SKU range per order. On average, the number of shipments is 1.36. This density of shipments per order increases with the number of SKUs per order. In ranges of less than 7 SKUs, the number of shipments required is less than 2. However, when the order has more than 7 SKUs, the number of shipments increases substantially: 2.82 shipments for orders between 7 and 10 SKUs, 5 shipments for orders between 11 and 20 SKUs, and 8 shipments for orders between 20 and 100 SKUs.

SKU RANGE PER ORDER	AVE.SHIPMENT/ORDER	AVERAGE UNFILLED ITEMS
BELOW 2	1.00	0.00
BETWEEN 2 AND 3	1.04	0.00
BETWEEN 3 AND 5	1.32	0.00
BETWEEN 5 AND 7	1.88	0.01
BETWEEN 7 AND 10	2.87	0.02
BETWEEN 11 AND 20	4.85	0.06
BETWEEN 20 AND 100	7.92	0.89
TOTAL	1.36	0.01

Table 20: Average number of shipments and unfilled items by SKU range

Figure 35 plots the number of unfilled items against the total quantities ordered and against the number of shipments per order, broken down by the date ordered. The bubble concentration shows the number of shipments per order.

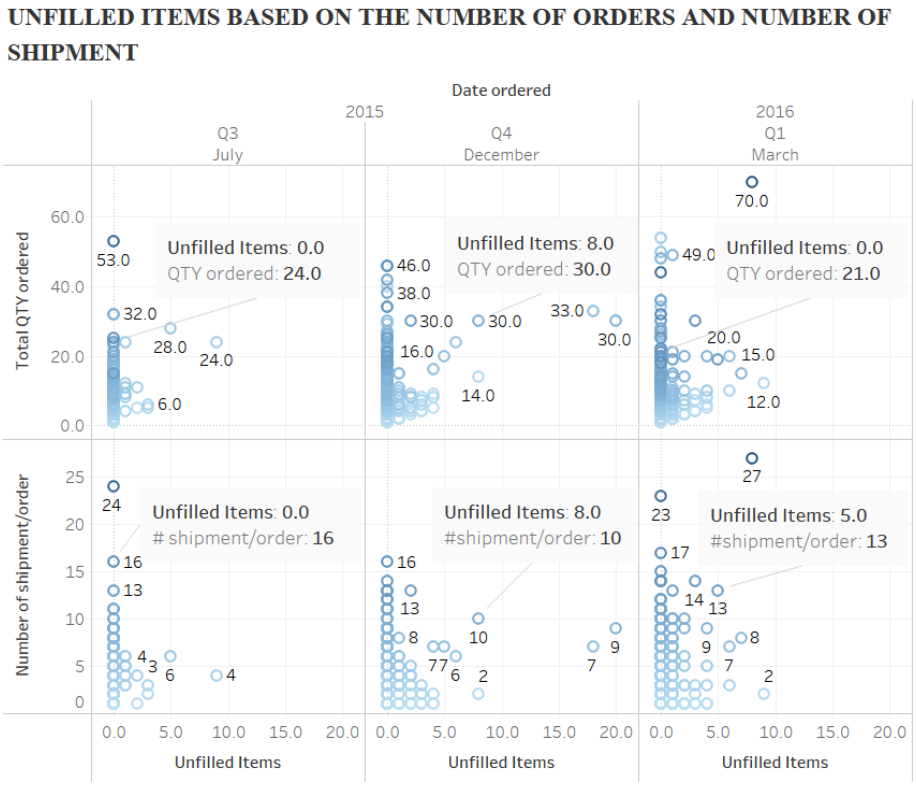


Figure 35: Unfilled items based on the number of orders and number of shipments

b) Fill rate of the door-crashers

Table 21 Table 1shows the important characteristics of the top 30 most ordered SKUs: number of items per order, the ratio of shipments to the number of items in the shipments, free shipping effects on quantities being ordered, and fill rate. The order of the SKUs is arranged by popularity, which means that the most ordered items appear at the top of the list. These items are known as "door-crashers" due to their popularity, and their order occurrence is often linked to both the free shipping promotion, as indicated by the second-to-last column ("free shipping effect"), and also linked to the stock-out incidence.

The second column shows the average number of items per order. The third column shows the ratio of number of shipments per number of items, which is often used to quantify whether

orders are split into more shipments than others. For example, the top two SKUs have approximately the same popularity, but the first item has a lower shipments/item ratio (0.2) than the second SKU (0.6). A ratio of 0.2 shipments/item means one shipment has approximately 5 items, which costs less than the SKU with 0.6 shipments per item ratio which uses 3 shipments to deliver 5 items.

Table 21 also summarizes the percentage of quantities ordered, the percentage of quantities shipped, and the fulfillment rate by SKU of the top 30 most-ordered SKUs. 90% of the SKUs below are fulfilled 100%. As highlighted in yellow, the unfulfilled rate is extremely high for the SKU 410010952990, which is ranked sixth in terms of number of orders. For this SKUs, in all orders, The Company fulfilled only 74% of the total demand. These stocks are mostly offered during promotion periods at both the store channel and the online channel.

The difference between quantities ordered and quantities shipped for the SKUs, indicated by the last column ("fill rate"), shows the gap between inventory availability online and the real availability. The larger gaps could be explained by reasons, including 1) the store does not take up the order in time to fulfill, resulting in its availability status no longer being accurate after being accepted from the store, or 2) the speed at which the system displays the inventory in real-time does not reflect the real inventory in the system. In general, the extremely low fill rate for door-crasher items due to stock-out is a prominent problem for online fulfillment. The persistence of this problem could cause low customer satisfaction and gradually lead to losing unsatisfied customers.

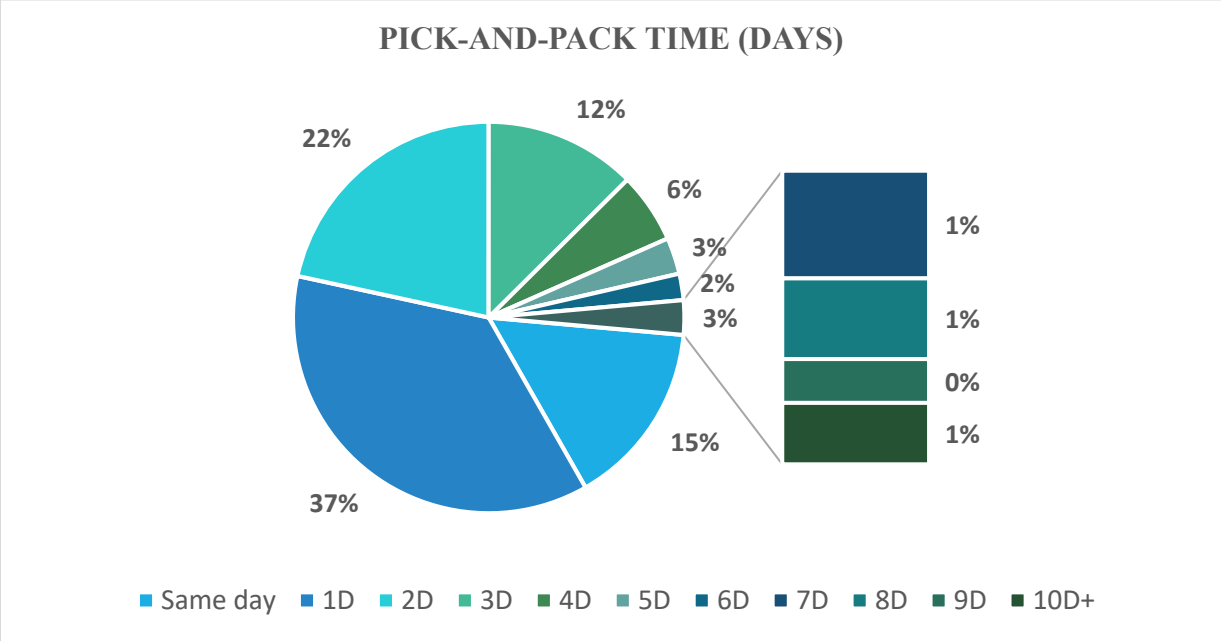
SKU ID	Number of items/order	Number of shipment/number of item	Free shipping effects	Fill rate
410012000019	9.8	0.2	100%	99%
400007829053	1.6	0.6	97%	100%
410011999956	9.7	0.2	100%	92%
410013796201	1.3	0.8	94%	100%
410011106088	1.3	0.8	99%	100%
410010952990	4.6	0.2	87%	74%
410011106095	1.4	0.7	95%	100%
410012720948	8.3	0.2	92%	100%
410013309203	1	1	99%	100%
410012721006	7.3	0.3	90%	100%
410014232852	1.2	0.8	100%	100%
410013591592	1	1	96%	100%
410013630086	1.1	0.9	100%	100%
410014232951	1.1	0.9	100%	100%
410013491922	1	1	100%	100%
410013560451	1.1	0.9	100%	100%
410013630093	1.1	0.9	100%	100%
410013295803	1	1	87%	100%
410013342118	1	1	92%	100%
410013166165	3.4	0.3	65%	100%
400007687936	2.5	0.4	54%	100%
410013644809	1.2	0.9	100%	100%
410013411715	1	1	100%	100%
410013798571	1.3	0.8	98%	100%
410013591608	1	1	97%	100%
410013309210	1	1	100%	100%
410013069886	1	1	95%	100%
410011998027	1.4	0.7	58%	100%
410013906808	1.5	0.7	52%	100%
410013644793	1.2	0.8	100%	100%

Table 21: Top 30 popular SKUs by SKUS per order, number of shipment vs. number of items, free shipping effect, and fill rate

c) Fulfillment time

There are three time-windows in the fulfillment process: the order processing window, the pick-and-pack window and the order shipping window. The available data only allows this research to assess the pick-and-pack time and the shipping time. The pick-and-pack window opens

from the moment an order is accepted and closes when it is shipped from the store. The Company aims to deliver within 4-8 days except for orders shipped to remote locations. Figure 36 shows the actual days to pick and pack an order at the store. Around 70% of orders are filled within two days, and 4% are fulfilled only by day seven. Figure 36 shows that the average time to pick and pack an order is 1.95 days. In the sample in this study, July 2015 outperformed other months, while December 2015 underperforms with slightly a longer pick-and-pack time than March 2016.



SAME DAY	1D	2D	3D	4D	5D	6D	7D	8D	9D	10D+
15%	37%	22%	12%	6%	3%	2%	1%	1%	0%	1%

Figure 36: Pick-and-pack time from store

The Company currently uses Purolator's Express service which gives a guarantee of one-day delivery for most customers in local and regional areas. Some delivery points are within 2-day range. Shipping time begins to be counted after the fulfilling store transfers the parcel to Purolator's Express.

Figure 37 shows the fulfillment time from the store across the month and classifies fulfillment time based on the days The Company takes to pick, pack, and ship, which varies from month to month. It is observed that The Company is doing extremely well in terms of shipping time, with less than 1.2 day on average to ship across months in the sample data. However, the

pick-and-pack time has a much greater variance. The longest time to ship is seen in December 2015 (2.11 days compared to 0.56 days in July and 2.07 days in March).

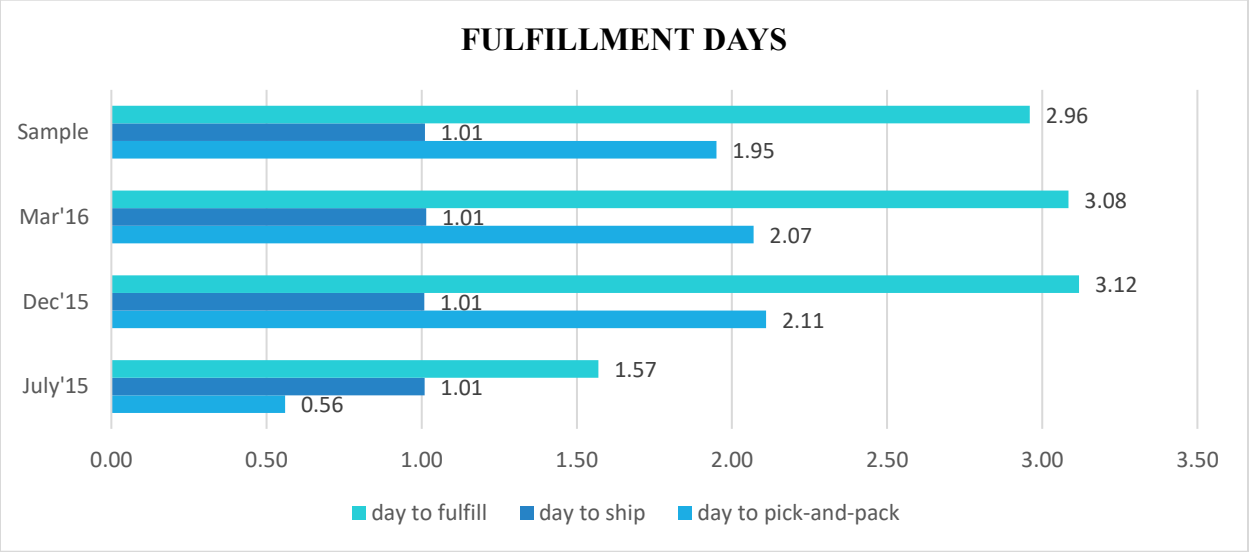


Figure 37: Fulfillment time from store by month (Purolator)

Almost 98% of orders met the fulfillment promise of 4 to 8 days. Two percent of product orders were fulfilled in 9 days or more due to the variance in picking and packing. This evidence exposes the weakness of picking from store. This shortfall of performance may be caused by virtual inventory management and the design of order transfer from store to store.

DAYS TO FULFILL	PERCENTAGE OF ORDERS
1	13.01%
2	34.04%
3	23.58%
4	13.64%
5	6.76%
6	3.42%
7	2.33%
8	1.22%
9D OR MORE	2.01%

Table 22: Percentage of orders by fulfillment days

In summary, The Company's SFS policy allows inventory to be pooled between stores, with each store playing the role of a local fulfillment facility. This system disadvantages online

fulfillment in terms of pick-and-pack time in comparison to any centralized fulfillment center, as pick-and-pack time and accuracy at each store vary. Store staffs place a higher priority on store operations over online sales fulfillment. The Company is currently using a premium shipping service, Purolator's Express, to make up for any possible delay caused by decentralized fulfillment and to guarantee service performance.

5. SUMMARIZED PROBLEMS FOR CURRENT ONLINE FULFILLMENT OPERATIONS

The Company operates in a country that has a widely-dispersed population, leading to a very low concentration of orders per region, and this disadvantages The Company's fulfillment in terms of costs and fill rate. Because there is demand for a wide variety of SKUs offered online, there is little demand concentration. The current decentralized fulfillment design lessens these disadvantages by routing online orders to stores based on customers' locations, pooling the total system's inventory, and allowing The Company to cut fulfillment time with regional and local delivery, (i.e., the nearest store is alerted first under the current algorithm). With SFS, the existing online fulfillment system allows flexibility in fulfilling online orders thanks to the large network of stores all across Canada. This integration creates a huge advantage for The Company, lowering inventory and facility costs relative to if there was a separate system for different sales channel.

The Company needs to tackle the following problems: 1) increase fulfillment efficiency to lower handling cost for online sales; 2) reduce shipping time and improve fill rate to increase service level; 3) reduce shipping expenses to lower online fulfillment cost; and 4) increase order value density to achieve a higher profit. These problems can be tackled by the following approaches as shown in Table 23 below:

PROBLEMS	**APPROACH**
Reduce shipping expenses per order to lower online fulfillment cost	Alternative shipping services from other available suppliers might reduce shipping expenses significantly and thus increase net profit

Increase order value density to achieve higher profit	Free shipping promotions, as demonstrated in sales data from December 2015, proved effective, but the high volume of orders and low fill rate on the door-crashers are not desirable for customer service. Conditional free shipping applied from March 2016 had important effects on order value density and profit margin. However, as other competitors constantly have a lower threshold for free shipping, the current conditional free shipping program could be made more competitive by lowering last-mile delivery cost
Enhance fulfillment efficiency to lower handling cost	Centralized fulfillment can eliminate the high cost of order handling, such as labor cost of picking and packing.

Table 23: Summary of fulfillment problems and solution approaches

In general, centralized fulfillment with automation of the fulfillment process will increase the service level compared to SFS. The cost and profit problems could be solved by better management of CEP shipping services, including choosing a lower-cost service which still allows a desirable shipping time.

B. Alternatives to existing online fulfillment center design and shipping service design

This section will evaluate possible alternative approaches for online fulfillment design to eliminate the problems of SFS, the current approach. Specifically, this section will consider how the centralization of online fulfillment will affect financial performance (through shipping costs, handling costs, total revenue, and total profit) and service performance (through pick-and-pack time and shipping time).

1. DEMAND GROWTH ASSUMPTION

This analysis aims at measuring the sensitivity of demand to changes in a range of important factors including market demand and e-commerce sales growth. This analysis uses two possible apparel online sales growth rate projections. The first scenario, an internal estimate provided by The Company, assumes a more optimistic growth rate, while the more moderate growth rate of the second scenario, the industry estimate, is based projections from Euromonitor

(Euromonitor, 2015). Table 24 presents two different growth rates for online demand. The source of estimate gives the value of year-on-year (YoY) growth rate, while the timeline and the investment amount required for centralized FC varies. Without having projection data beyond 2020, this analysis makes the assumption that the growth rate will stabilize at a constant rate from 2023 to 2026 according to The Company's internal estimate and from 2020 to 2026 according to the Industry's estimate by Euromonitor.

SOURCE*	YEAR	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*	*2025*	*2026*
Internal Estimate	YoY growth	83%	60%	44%	52%	43%	24%	15%	10%	10%	10%
Industry Estimate	YoY growth	17%	15%	4%	15%	15%	15%	15%	15%	15%	15%

Table 24: Relationship between demand growths – two growth rate scenarios

2. CHANGES OF CEP SERVICE SUPPLIERS

a) The determinants for the shipping cost per shipment by Canada Post

The Company currently contracts a parcel carrier for last-mile delivery, which allows the retailer to focus on its core operations. Currently, Purolator's Express is the service of choice, guaranteeing delivery to most destinations in Canada by the end of the next business day. Due to the high cost of this premium service, The Company sees the benefits of diversifying its shipping service contract to lower the overall costs. The management is considering engaging Canada Post as a comparable service provider.

Canada Post's two main services, Priority and Xpresspost, offer service levels similar to those of Purolator's Express. If The Company chooses to adopt the two new services, they will have two main CEP companies providing three different services: Canada Post's XpressPost, Canada Post's Priority and Purolator's Express. As shown in Table 25, the general service commitment and the shipping time provided by Canada Post's XpressPost and Priority (Canada Post, 2016) is comparable with that of Purolator's Express (Purolator's Express, 2016).

SERVICE	PUROLATOR'S EXPRESS-EXPRESS	CANADA POST-XPRESSPOST	CANADA POST-PRIORITY
LOCAL	End of next business day	Next day	Next day
REGIONAL	End of next business day	Next day	Next day
NATIONAL	End of next business day	2 days	Next day

Table 25: General service commitment for shipping time (Canada Post, 2016; Purolator's Express, 2016)

Figure 38 presents the three services, their costs to the customers and the shipping charges to the customers per order. As illustrated in Figure 39, for each of these services, at a shipping charge of $8.50, The Company has various shipping charge schedule for its online customers: 1) a flat shipping charge of $8.50, and 2) FS at an order value threshold of $70. As suggested by previous studies of the order density effect on profit per order (Section II.G.4 – Quantitative studies on CEP shipping service and profitability shipping policies), total profit increases as the retailer applies the shipping threshold. Thus, this research eliminates the choice of flat shipping charge in assessing all the coming year's profit. All shipping services proposed below charge $8.50 per order for order value less than the threshold.

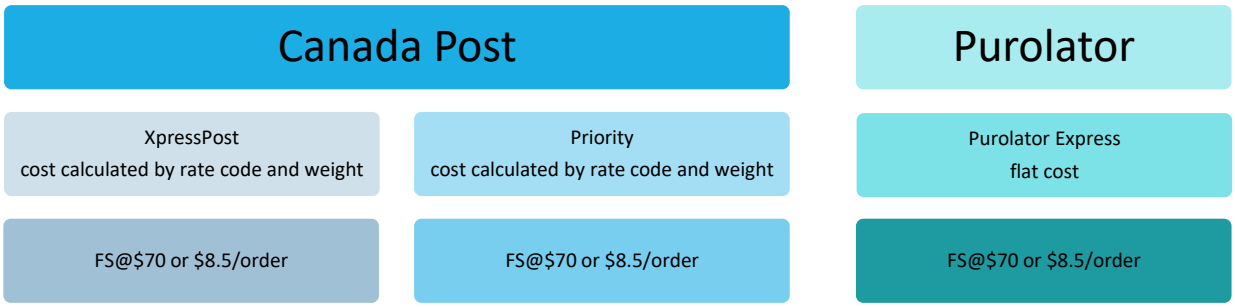


Figure 38: CEP service choices and their respective charges to the customers

- Rate Code: determined by the postal codes of the sending store(s) and the package's destination. Using the Rate Code Look-up Table, an online tool provided by Canada Post, the researcher finds all the rate codes in Canada based on postal code and pairs them with the postal code from all the FCs respectively. The Rate Code for local shipping is 1, With increasing shipping distance shown through progressively higher rate codes.
- Order's weight: deducted from the item's value based on price bracket of a similar product category. Currently, this type of data is not necessary under the arrangement with Purolator's Express. Assuming a relationship between order value and weight, this study

uses order value to gauge weight range. This relationship is established based on available data between product category and weight from an online retailer who sells similar apparel products, as shown in Table 46 (Appendix). According to Table 26, a winter jacket's weight is between 1.5 kg and 2.0 kg per item (Shopozz, 2016). Data on the category's weight is then linked back to the retail value for each these categories on The Company's websites. For example, the mentioned winter jacket is listed at an average value range of $150 and $200. Thus, in Table 26, the winter jacket with its average weight of 2.0 kg is listed in the second-to-last row with a minimum price of $151 and a maximum price of $200. The establishment of the link between order value and product weight is helpful in determining the cost charged by Canada Post for each service type used in the study.

Weight and value assumption per product category			
Product category	**Price Min (>=) ($CA)**	**Price Max (<) ($CA)**	**Category Weight (kg)**
Underpants, shirt, t-shirt, shorts, jersey, dress, leggings hoodie, hat, scarf, gloves, slippers	0	25	0.5
Pants, jeans, sandals, running shoes, moccasins	25	50	0.75
Sports-shirt, wind-breaker, jacket, shoes	51	100	1
Coat, duster, autumn jacket	101	150	1.5
Winter jacket, boots	151	200	2
High boots	201	1000	2.5

Table 26: Weight and value assumption by product category (Shopozz, 2016)

- Shipping cost per shipment: Table 27 demonstrates the relationship between the rate code and the shipping cost. For example, using two arbitrary pairs of origins and destinations (Scarborough, ON to Frohlich, ON and Woodbridge, ON to Toronto, ON) using Priority and Xpresspost delivery service, the shipping costs to The Company are $6.10 and $9.10 for the first order and $6.30 and $9.70 for the second order.
- Shipping cost per order: calculated based on the number of shipments per order

CPE services performance-related data

- Canada Post's shipping time: the time to ship the hypothetical parcel from Scarborough, ON to a customer in Frohlich, ON is one business day for both of Canada Post's delivery services. Most origin-destination pairs that have the same rate code have the same day of shipping for the same service type. For the shipping time from Woodbridge, ON to Toronto, ON, instead of the standard one-day shipping by Purolator's Express, Canada Post's Priority and Xpresspost rate codes are good indicators for shipping days. As Table 27 suggests, the alternative shipping times are calculated for each delivery service, which shows a shipping time of 1 day for both services in the comparison.

Origin	Postal code - sender	Shopper	Postal code - customer	Rate code	Order value ($CA)	Parcel weight (kg)	Shipping cost		Shipping time	
							Xpresspost	Priority	Xpresspost	Priority
Scarborough - ON	M1H	Frohlich-ON	L3R	1	50	0.5	6.1	9.1	1	1
Woodbridge - ON	L4L	Toronto-ON	M9M	1	100	0.75	6.3	9.7	1	1

Table 27: Relationship between the rate code, the parcel's weight, the shipping costs and shipping time by Canada Post services

b) Total saving on shipping expenses

This section evaluates the effects of high shipping cost on profitability and shows the positive impact of the alternative CEP by substituting the cost charged by the current CPE service provider, Purolator's Express, with those charged by Canada Post's Xpresspost (referred to from now on as "Xpresspost") or by Canada Post's Priority (referred to from now on as "Priority").

Table 28 below summarizes the average shipping cost of an average parcel between provinces/territories using Xpresspost and Priority. According to Table 28, the shipping cost charged by Xpresspost for an average parcel ranges from $5.30 to $22.30. Similarly, costs charged by Priority for parcels of similar dimensions range from $8.00 to $33.30. As highlighted in red, the top 10 expensive routes for shipping expenses calculated for both services are those received from or sent to the Territories and from SK to MB. The value in green cells indicates the in-province average shipping cost per parcel. For Xpresspost, the shipping rates within QC ($5.30), ON ($5.40), BC ($5.40) and AB ($5.70) are lowest while those within the Territories are highest. Similarly, considering Priority, the cheapest shipping costs per parcel for in-province shipment are BC ($8.00), QC ($8.10), ON ($8.30), and AB ($8.50). The cells that have an "NA" value indicate the unavailability of the fulfillment route between those provinces due to the store assignment of Quick Search, which restricts certain combinations of origin-destination. For example, there is no fulfillment from PE to NT or YT. This results in lower shipping costs required for very remote areas.

Xpresspost - AVERAGE SHIPPING COST PER SHIPMENT – SFS													
	CUSTOMER PROVINCE												
STORE PROVINCE	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	**Average**
AB	5.7	10.5	11.5	14.3	16.0	16.6	14.0	13.3	14.3	13.4	6.2	14.0	8.7
BC	9.9	5.4	13.5	13.9	15.3	16.1	14.2	12.5	14.7	12.7	12.3	12.1	7.4
MB	11.5	11.9	6.2	15.4	14.6	17.8	13.9	10.1	12.8	11.8	6.2	14.6	8.7
NB	11.9	11.3	11.0	5.8	13.5	17.2	6.2	11.4	6.1	10.0	13.2	13.6	8.2
NL	12.6	13.2	13.3	12.7	5.7	19.5	12.8	12.4	12.5	9.0	12.2	NA	8.6
NS	12.7	12.0	10.3	5.8	13.2	22.3	5.8	10.9	5.9	11.3	11.8	NA	8.3
ON	12.2	12.0	10.4	12.3	15.7	17.3	12.1	5.4	13.1	5.9	11.9	13.8	6.4
PE	11.9	13.3	12.8	5.9	13.3	NA	6.0	10.9	5.9	12.5	22.3	NA	8.6
QC	12.0	11.6	11.4	9.7	14.3	17.8	11.7	5.7	12.4	5.3	12.4	12.9	7.9
SK	5.9	11.1	6.4	15.0	16.3	16.4	15.0	11.7	14.7	13.2	5.9	15.4	8.7
YT	15.0	13.6	15.3	12.7	17.1	17.5	15.0	12.2	NA	12.1	14.0	14.8	13.7
Average	7.4	7.9	8.8	8.6	12.0	17.1	9.1	6.5	9.4	6.9	7.7	13.3	7.5
PRIORITY - AVERAGE SHIPPING COST PER SHIPMENT – SFS													
Provinces	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	**Average**
AB	8.5	20.4	22.6	25.0	27.3	28.2	25.1	24.1	25.3	24.3	9.0	25.5	15.0
BC	19.0	8.0	24.9	24.7	27.3	28.2	25.1	23.4	26.1	23.9	24.5	22.8	12.5
MB	23.2	22.9	9.5	25.5	25.6	29.1	24.6	19.3	23.8	23.3	9.0	25.2	15.4
NB	22.9	22.3	21.9	8.7	26.2	29.2	9.1	23.0	9.1	19.1	24.6	22.3	14.4
NL	23.9	24.1	24.8	24.8	8.7	30.7	24.8	23.9	24.9	15.7	24.2	NA	15.1
NT	23.6	22.9	21.9	8.7	26.1	33.3	8.7	22.6	8.8	22.8	23.3	NA	14.8
ON	23.2	22.9	20.4	24.0	27.5	28.5	23.4	8.3	24.9	9.2	24.0	24.3	10.5
PE	22.6	24.8	24.6	8.8	25.9	NA	8.9	22.3	8.8	25.0	32.2	NA	15.4
QC	23.0	22.4	23.0	17.8	25.5	29.7	23.5	8.8	24.5	8.1	23.7	23.7	13.7
SK	8.7	22.6	9.7	26.1	27.9	28.6	26.0	23.2	25.7	24.3	8.7	26.8	15.2
YT	25.3	25.1	26.2	27.6	27.9	29.4	24.7	22.9	NA	22.0	24.9	22.8	24.5
Average	12.6	13.9	15.8	14.9	21.5	28.8	16.2	10.7	16.6	11.4	12.9	24.0	12.7

Table 28: Average shipping cost in dollars per shipment from store using Xpresspost and Priority

Table 29 shows the percentage of shipping cost of fulfilling from stores to customers by province. The cells that are highlighted in red in Table 29 are the ten most expensive shipping values. Their weights in the shipment values are not substantial and thus do not influence the shipping cost significantly. For both Xpresspost and Priority, the highest percentage of shipping costs are for those within the provinces of ON, AB, BC, and those that fulfill across provinces: AB to ON, QC to ON, AB to BC, ON to AB, ON to BC, and QC to NL.

Xpresspost – PERCENTAGE SHIPPING COST – SFS													
	CUSTOMER PROVINCE												
STORE PROVINCE	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	**Average**
AB	6.3%	3.7%	1.3%	0.4%	0.6%	0.3%	0.6%	5.1%	0.2%	0.5%	0.8%	0.1%	19.8%
BC	1.6%	5.1%	0.3%	0.1%	0.2%	0.1%	0.2%	2.0%	0.1%	0.2%	0.4%	0.1%	10.3%
MB	0.3%	0.3%	1.2%	0.1%	0.1%	0.0%	0.2%	1.4%	0.0%	0.1%	0.2%	0.0%	3.8%
NB	0.1%	0.1%	0.0%	0.9%	0.6%	0.0%	0.5%	0.8%	0.1%	0.2%	0.0%	0.0%	3.5%
NL	0.1%	0.1%	0.0%	0.1%	0.9%	0.1%	0.3%	0.7%	0.1%	0.1%	0.0%	0.0%	2.4%
NS	0.2%	0.1%	0.0%	0.4%	1.3%	0.0%	1.5%	1.0%	0.2%	0.2%	0.0%	0.0%	5.1%
ON	2.5%	2.3%	1.0%	0.8%	1.2%	0.1%	1.2%	25.6%	0.2%	0.9%	0.7%	0.0%	36.5%
PE	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.8%
QC	0.9%	0.9%	0.3%	0.9%	1.7%	0.1%	1.7%	4.4%	0.4%	1.5%	0.2%	0.0%	13.0%
SK	0.3%	0.4%	0.5%	0.1%	0.1%	0.0%	0.2%	1.5%	0.1%	0.1%	1.0%	0.0%	4.5%
YT	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.4%
Average	12.4%	13.0%	4.7%	3.9%	7.1%	0.9%	6.5%	42.6%	1.5%	3.7%	3.4%	0.3%	100.0%
PRIORITY - PERCENTAGE SHIPPING COST – SFS													
Provinces	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	**Average**
AB	5.5%	4.2%	1.5%	0.4%	0.6%	0.3%	0.6%	5.4%	0.2%	0.5%	0.7%	0.1%	20.0%
BC	1.8%	4.5%	0.3%	0.1%	0.2%	0.1%	0.2%	2.2%	0.1%	0.2%	0.4%	0.1%	10.2%
MB	0.3%	0.3%	1.0%	0.1%	0.1%	0.0%	0.2%	1.5%	0.0%	0.1%	0.1%	0.0%	3.9%
NB	0.1%	0.1%	0.0%	0.8%	0.7%	0.0%	0.4%	1.0%	0.1%	0.2%	0.0%	0.0%	3.6%
NL	0.1%	0.1%	0.0%	0.1%	0.8%	0.1%	0.3%	0.7%	0.1%	0.1%	0.0%	0.0%	2.5%
NT	0.2%	0.2%	0.0%	0.3%	1.6%	0.0%	1.3%	1.2%	0.2%	0.2%	0.1%	0.0%	5.3%
ON	2.8%	2.6%	1.1%	0.9%	1.3%	0.1%	1.4%	23.2%	0.3%	0.8%	0.8%	0.0%	35.2%
PE	0.0%	0.0%	0.0%	0.1%	0.3%	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%	0.8%
QC	1.0%	1.0%	0.3%	1.0%	1.8%	0.1%	2.0%	4.0%	0.5%	1.3%	0.3%	0.0%	13.3%
SK	0.3%	0.5%	0.5%	0.1%	0.1%	0.0%	0.2%	1.8%	0.1%	0.1%	0.9%	0.0%	4.6%
YT	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.4%
Average	12.4%	13.5%	4.9%	4.0%	7.5%	0.9%	6.8%	41.3%	1.5%	3.6%	3.3%	0.3%	100.0%

Table 29: Percentage of shipping cost from store using Xpresspost and Priority

As discussed in the Data Description (section IV.A.1.a), The Company uses Purolator's Express, which charges a fixed cost for parcels sent from any store in the network to any customer in any Canadian territory. Table 30 shows the percentage of shipping cost value when using Xpresspost, Priority, and Purolator's Express to all provinces and territories in comparison with the percentage of shipment value to those provinces respectively. The first row shows the shipment value weight by provinces while the following rows indicate the shipping cost weight for each shipping service. The red cells highlight the options that disadvantage The Company financially. The alternative services offer cost saving compared to Purolator's Express in the major provinces,

where the shipping cost portion is lower than the weight of shipment value. These provinces include ON, QC, and AB. Table 29 above confirms that the higher-than-average shipping cost per parcel for those shipments to and from remote areas, such as the Territories, SK and MB, don't have a big impact on the total shipping cost due to their small shipment values: YT (0.2%), NT (0.6%), SK (1.4%), and MB (1.3%). However, due to the regional and national shipping charge schedules from Canada Post, shipments to these areas have a higher shipping cost percentage than their weight of order value. The highlighted values in Table 28 shows high shipping charges to those provinces where the orders come from.

SHIPPING COST DISTRIBUTION – SFS												
Customer provinces	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**
Shipment value (%)	**12.6%**	**11.9%**	**4.1%**	**3.5%**	**4.5%**	**0.6%**	**5.6%**	**48.6%**	**1.2%**	**4.0%**	**3.3%**	**0.2%**
Purolator's Express Shipping cost (%)	12.5%	12.4%	4.0%	3.4%	4.4%	0.4%	5.4%	49.1%	1.2%	4.0%	3.3%	0.1%
Xpresspost shipping cost (%)	12.4%	13.0%	4.7%	3.9%	7.1%	0.9%	6.5%	42.6%	1.5%	3.7%	3.4%	0.3%
Priority shipping cost (%)	12.4%	13.5%	4.9%	4.0%	7.5%	0.9%	6.8%	41.3%	1.5%	3.6%	3.3%	0.3%

Table 30: Percentage of shipping cost from store to different provinces using Xpresspost, Priority, and Purolator's Express

Table 31 shows that The Company can save substantially by switching to Canada Post. Using the current shipping expenses charged by Purolator's Express as the Shipping Expense Index, The Company would pay only a fraction of the current cost using Xpresspost or Priority. To all destinations of orders, the cost lines of both alternative services are fractions of the current shipping expenses. For an average shipment, the ratio of Xpresspost's cost to the current Shipping Expense Index is 32%, and that of the Priority is 55%. Generally, an average order sent by Xpresspost and by Priority would cost 6.97 and $11.84 respectively versus $22.60 charged by Purolator's Express. The reduction is translated to a savings of between $10.76 and $15.63 per order for Priority and Xpresspost respectively. With a volume of approximately 240,000 shipments per year, the switch of CEP service provider and service will yield extra profit of between $2,582,400 and $3,751,200 per year for online sales. This increase is equivalent to 315% and 217% higher than the current profit of around $1,189,706 using Purolator's Express.

SHIPPING EXPENSE INDEX – XPRESSPOST AND PRIORITY VS. PUROLATOR'S EXPRESS - SFS													
Customer provinces	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	**All**
Xpresspost (%)	32%	34%	38%	38%	52%	63%	40%	28%	41%	30%	33%	54%	32%
Priority (%)	54%	60%	69%	65%	94%	106%	70%	46%	72%	50%	56%	98%	55%
SHIPPING COST PER SHIPMENT - XPRESSPOST AND PRIORITY VS. PUROLATOR'S EXPRESS													
Xpresspost	6.92	7.34	8.23	8.14	11.30	13.55	8.56	6.06	8.80	6.48	7.19	11.65	6.97
Priority	11.69	12.92	14.82	14.07	20.23	22.82	15.23	9.96	15.55	10.75	12.10	21.11	11.84

Table 31: Shipping expense index and shipping cost per shipment – Xpresspost and Priority vs. Purolator's Express – SFS

In replacing Purolator's Express shipping service, the increase in profit will grow even more significantly as sales from the online channel grow and the shipping cost savings increase proportionally. Table 32 shows the sensitivity analysis for the shipping cost savings based on the different growth rate of demand from 2017 to 2026 (see Table 24 regarding demand growth rate assumption). The table shows the total increase in profit by year in two scenarios: 1) Internal growth rate of 28.4% in CAGR; and 2) Industry growth rate of 13.6% in CAGR for online apparel goods (Euromonitor, 2015).

YEAR	INTERNAL	SAVING PER YEAR		INDUSTRY	SAVING PER YEAR	
		Xpresspost - $15.63/shipment	Priority - $10.76/shipment		Xpresspost - $15.63/shipment	Priority - $10.76/shipment
2017	83%	6,882,936	4,738,349	17%	**4,405,858**	**3,033,079**
2018	60%	6,001,920	4,131,840	15%	**4,330,643**	**2,981,300**
2019	44%	5,392,350	3,712,200	4%	**3,913,333**	**2,694,016**
2020	52%	5,708,348	3,929,739	15%	**4,302,626**	**2,962,013**
2021	43%	5,358,857	3,689,143	15%	**4,302,626**	**2,962,013**
2022	24%	4,651,488	3,202,176	15%	**4,302,626**	**2,962,013**
2023	15%	4,313,880	2,969,760	15%	**4,302,626**	**2,962,013**
2024	10%	4,126,320	2,840,640	15%	**4,302,626**	**2,962,013**
2025	10%	4,126,320	2,840,640	15%	**4,302,626**	**2,962,013**
2026	10%	4,126,320	2,840,640	15%	**4,302,626**	**2,962,013**
CAGR		**28.4%**			**13.6%**	
AVE. SAVING PER YEAR		**5,068,874**	**3,489,513**		**4,276,822**	**2,944,248**

Table 32: Sensitivity analysis- shipping cost saving 2017-2026 in replacing Purolator's Express – SFS

Figure 39 shows the impact of shipping expense savings when assuming the internal growth rate or the industry growth rate. For the more positive scenario, shifting to Xpresspost and Priority will save the company an average of $5,068,874 and $3,489,513. In the less positive growth rate scenario, this saving is between $4,276,822 and $2,944,248.

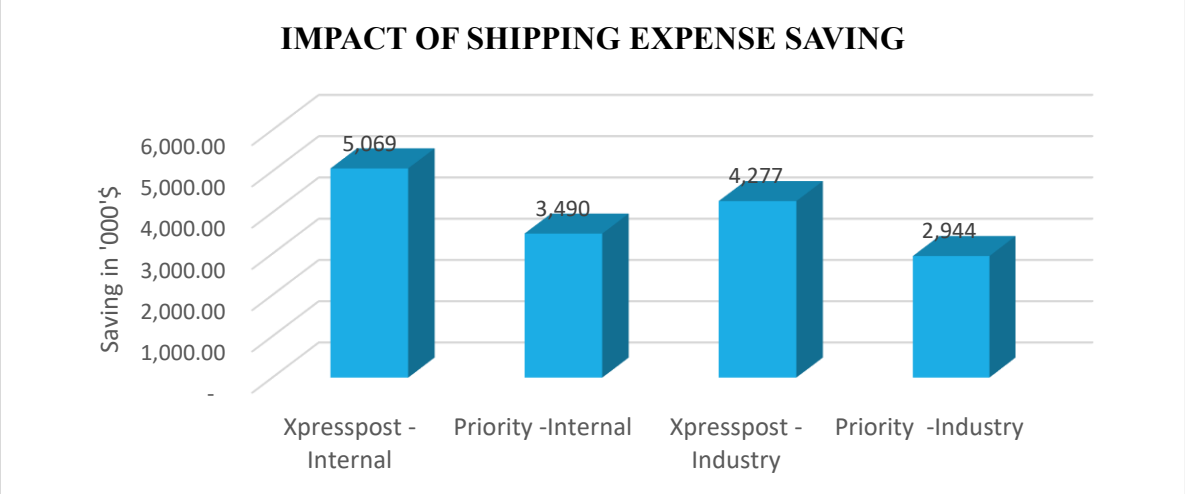


Figure 39: Impact of shipping expense savings by switching to Canada Post under different growth rates (Internal and Industry)

c) Changes in shipping time using Canada Post

This section shows the shipping time and fulfillment time using Canada Post's Xpresspost or Priority. The comparable data for Purolator has been shown in section IV.A.4.c) – Service Performance – Fulfillment time. Table 33 below summarizes the average shipping time of an average parcel from one province/territory to the other using Xpresspost or Priority. According to Table 29, the shipping days for an average parcel range from 1.7 days to 7.0 days with Xpresspost and from 1.5 days to 7.0 days with Priority. As highlighted in red, the top 10 longest shipping times calculated for both services are those received from or sent to the Territories and from NT and YT. The values in green cells indicate the in-province average shipping cost per parcel.

For Xpresspost shipping services, the shortest shipping times are seen within the Atlantic provinces (1.3 days), QC (1.3 days), MB (1.3 days), ON (1.3 days) while within-province shipping times for ON, BC, and AB are around 1.6 days. Those within the Territories are the highest (4.4 days to 7 days). Priority service offers slightly faster service for similar shipping routes. By using Priority, The Company can expedite the shipping time by around 0.2 days for any route. The cells that have an "NA" value indicate the unavailability of the fulfillment route between those provinces due to the store assignment in Quick Search. For example, there is no fulfillment from PE to NT and PE to YT.

Xpresspost - AVERAGE SHIPPING TIME TABLE – SFS													
Province	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	Average
AB	1.6	1.9	1.9	2.8	2.9	6.0	2.8	2.8	2.8	2.8	1.8	4.3	2.0
BC	2.1	1.6	2.9	2.9	3.1	6.5	3.0	2.7	3.1	2.9	2.3	2.9	1.9
MB	2.4	2.5	1.3	2.7	2.8	6.7	2.8	2.4	2.4	2.4	1.9	4.0	2.0
NB	3.0	3.0	3.0	1.4	1.9	7.0	1.9	2.4	1.5	2.6	3.0	3.0	1.9
NL	2.8	2.8	2.8	2.3	1.5	4.4	2.1	2.8	2.2	2.8	2.9	NA	2.0
NS	3.0	3.0	3.0	1.6	1.9	7.0	1.2	2.4	1.4	2.6	3.0	NA	1.7
ON	2.7	2.8	2.7	2.8	2.9	5.9	2.8	1.6	2.8	1.8	2.8	3.6	1.7
PE	3.0	3.0	3.0	1.7	1.9	NA	1.9	2.4	1.4	3.4	3.0	NA	1.9
QC	2.8	2.8	2.9	2.9	3.0	6.5	3.0	1.7	3.0	1.3	2.8	3.6	2.1
SK	1.6	2.8	1.7	2.8	2.8	6.7	2.9	2.8	2.8	2.8	1.6	5.7	2.2
YT	2.9	3.0	2.9	4.0	4.0	4.0	4.0	3.8	NA	3.3	3.4	2.0	3.3
Average	1.9	1.9	1.9	2.1	2.3	6.1	2.1	1.7	2.1	1.7	2.0	3.5	1.9
Priority - AVERAGE SHIPPING TIME TABLE – SFS													
Province	**AB**	**BC**	**MB**	**NB**	**NL**	**NT**	**NS**	**ON**	**PE**	**QC**	**SK**	**YT**	**Average**
AB	1.5	1.9	1.8	2.5	2.7	5.9	2.6	2.1	2.5	2.2	1.8	4.1	1.8
BC	2.0	1.5	2.8	2.9	3.1	6.5	3.0	2.5	3.1	2.7	2.1	2.9	1.8
MB	1.6	2.0	1.2	2.4	2.6	6.6	2.6	1.7	2.4	1.9	1.6	3.7	1.6
NB	2.1	2.1	2.3	1.4	1.9	7.0	1.6	1.7	1.5	1.9	2.2	2.0	1.7
NL	2.5	2.5	2.4	2.2	1.5	4.2	2.1	2.4	2.2	2.4	2.4	NA	1.9
NS	2.3	2.2	2.3	1.5	1.9	7.0	1.1	1.8	1.4	2.0	2.4	NA	1.5
ON	1.8	1.9	1.9	1.8	2.0	5.1	1.9	1.5	1.8	1.7	1.9	2.7	1.6
PE	2.3	2.3	2.3	1.5	1.9	NA	1.7	1.7	1.4	2.5	2.5		1.7
QC	1.9	1.8	2.1	2.0	2.2	6.4	2.1	1.5	2.1	1.2	1.9	2.8	1.7
SK	1.6	2.0	1.7	2.6	2.8	6.7	2.7	1.9	2.5	2.3	1.6	5.7	1.8
YT	2.9	2.8	2.9	4.0	4.0	3.0	3.0	3.1	NA	2.3	2.9	2.0	2.9
Average	1.6	1.7	1.7	1.8	2.0	6.0	1.7	1.6	1.8	1.6	1.8	3.3	1.7

Table 33: Average shipping time using Xpresspost and Priority service- SFS

d) Changes in total fulfillment time

Table 34 shows the average number of business days required to pick-and-pack, to ship, and to fulfill orders. It is observed that The Company is currently doing extremely well regarding shipping time, with an average time of less than 2 days to fulfill across the month in the sample data. In changing CEP service providers, The Company might add 0.87 days (Xpresspost) or 0.66 days (Priority) to their current fulfillment days. In general, this lead-time is still below the standard fulfillment time, 8 days, which The Company promises to its customers. However, the shipping

time for the peak month has a much greater variance of duration. The month of December 2015 had higher than average shipping time for both services in consideration: 0.97 days for Xpresspost and 0.73 days for Priority.

MONTH	DAY TO PICK-AND-PACK	DAY TO SHIP		DAY TO FULFILL		
		XPRESSPOST	PRIORITY	XPRESSPOST	PRIORITY	PUROLATOR
JULY'15	0.56	1.94	1.68	2.50	2.24	1.57
DEC'15	2.11	1.84	1.64	3.95	3.75	3.12
MAR'16	2.07	1.98	1.74	4.05	3.81	3.08
SAMPLE	1.95	1.88	1.67	3.83	3.62	2.96

Table 34: Average business day to fulfill by month using Xpresspost and Priority service- SFS

3. CENTRALIZED FULFILLMENT

a) Demand growth rate

Table 35 shows the demand growth rate over time according to both the internal and external growth rate assumptions. This rate is translated into a number of orders per year while the daily fulfillment rate is calculated using the number of orders per year. This assumes that the new online FC is built to accommodate this capacity in the 10-year period starting with the year 2017. At the end of the investment horizon, the demand level assumed by the Internal rate is 878,277 orders while that of the Industry rate is 321,978 orders.

YEAR	INTERNAL GROWTH RATE	ORDERS/YEARS	DFR	INDUSTRY GROWTH RATE	ORDERS/YEARS	DFR
2016	**83%**	84,000	**230**	19%	84,000	**230**
2017	**60%**	134,400	**368**	19%	99,960	**274**
2018	**44%**	193,536	**432**	17%	117,405	**322**
2019	**52%**	294,175	**499**	15%	135,540	**371**
2020	**43%**	420,670	**521**	4%	141,399	**387**
2021	**24%**	521,631	**597**	15%	162,184	**444**
2022	**15%**	599,875	**685**	15%	186,025	**510**
2023	**10%**	659,863	**786**	15%	213,371	**585**
2024	**10%**	725,849	**902**	15%	244,737	**671**
2025	**10%**	798,434	**1,034**	15%	280,713	**769**
2026	**10%**	878,277	**1,186**	15%	321,978	**882**

Table 35: Demand requirement analysis for centralized FC

b) Options

There are various options for a new centralized FC in terms of locations and capabilities. These options would determine the level of investment. Firstly, The Company has the option to upgrade one of the two currently leased DCs for online fulfillment, repurposing the facility and investing in IT infrastructure and Warehouse Management. Alternately, The Company could build one new online FC either in Ontario, Alberta or Nova Scotia. For shipping charges, this analysis will use the suggested shipping services, Xpresspost or Priority, and their respective costs are taken into account. The objectives of these strategies are to meet the fulfillment demand, to minimize the total cost of the system, and to satisfy certain service-level requirements.

Figure 40 shows all of these options and their respective investment costs. The fixed costs of building a new online FC vary primarily based on its planned location. The Company is considering Halifax (NS), where a new facility would cost $70 million. If The Company opts instead to upgrade and repurpose an existing FC, there are three options: For upgrading and re-purposing the current central facility, the centralization of online fulfillment can take place at one of the following facilities: 1) Repurposing two DCs , and splitting fulfillment between Ontario's DC (Eastern cluster) and Alberta's DC (Western cluster), for a cost of $25 million; 2: Repurposing

Ontario's DC to serve all of Canada, for a cost of $10 million; and 3: Repurposing Alberta's DC to serve all of Canada, for a cost of: $15 million.

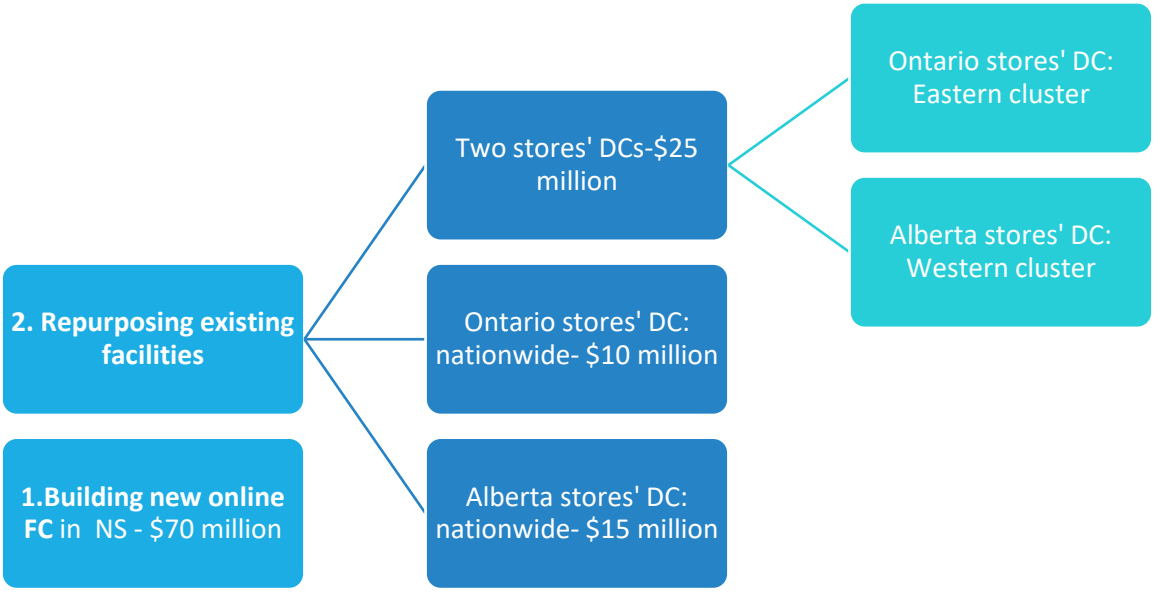


Figure 40: Available FC options and the investment amount required

c) Fulfillment center allocation

For the two centralized facilities, fulfillment center allocation is necessary. If the shipment is bound outside of its "home" city, to regional or national destinations, The Company would suffer a penalty in both financial performance and service performance. To ensure a high service level in terms of shipping time and to lower the shipping cost, the optimal fulfillment should avoid regional and national shipping. Table 36 defines how Canada Post classifies shipments by the province and region of shipping. A local shipment is an item that moves within a major urban area, city, town or village. For example, a parcel sent from Toronto within Toronto has a local rate. A regional shipping rate applies to an item that moves within a region, such as a shipment from Vancouver to Winnipeg. A national shipment is an item that moves between regions, such as a shipment from Charlottetown to Vancouver (Canada Post, 2016).

CLASSIFICATION	REGION	DETAIL
REGIONAL	Atlantic Region	Newfoundland and Labrador, Prince Edward Island, Nova Scotia, and New Brunswick
	Central Region	Quebec and Ontario (includes Northwestern Ontario Postal Codes: P7A-L, P8N, P8T, P9A, P9N, P0T-Y)
	Western Region	British Columbia, Alberta, Saskatchewan, and Manitoba (includes Northwestern Ontario Postal Codes: P7A-L, P8N, P8T, P9A, P9N, P0T-Y)
	Nunavut East Region	X0A
	Nunavut West Region	X0B, X0C
	Northwest Territories Region	X0E, X0G, X1A
	Yukon	Yukon
NATIONAL	Out of the local and regional shipping zone	Example: from Charlottetown to Vancouver

Table 36: Canada Post's classification of regional and national shipment (Canada Post, 2016).

Based on the shipping charge (Table 28) and the shipping time as they apply to regional and national shipping (Table 33), Figure 41 shows a suggested option that splits centralized fulfillment for online orders between the Eastern and Western clusters according to the concentration of customers' shipping addresses. Based on that, orders from AB, BC, SK, MB, NT, NV, and YK are grouped into the Western cluster and the rest of the provinces (ON, QC, and Atlantic) into the Eastern cluster. With 50% of customers' orders coming from ON and 22% from the rest of the Eastern cluster, the split option lowers shipping costs for delivery thanks to regional and local delivery rates and delivery times. In Figure 41, the left circle shows the percentage of orders being shipped from the DC of the Western cluster to each region within that cluster while the one on the right shows the allocation of the remaining orders.

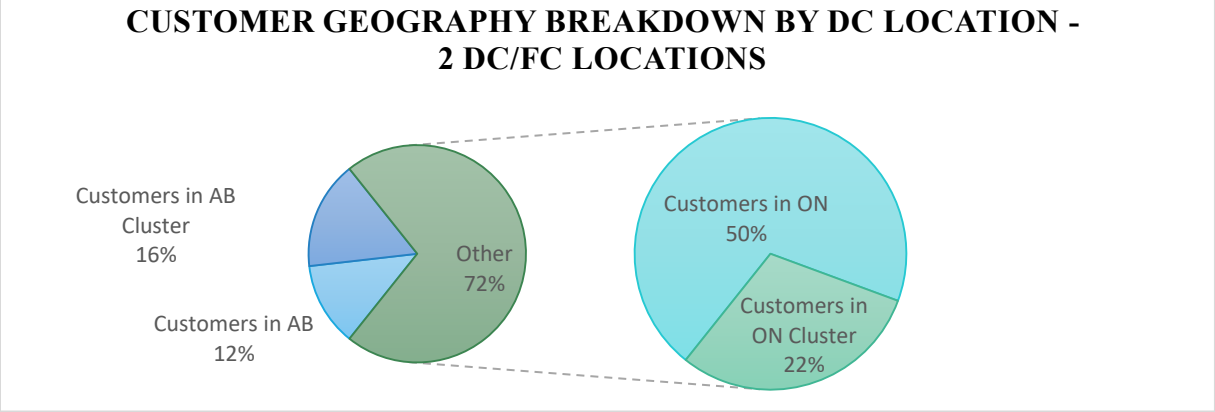


Figure 41: Customer breakdown in splitting centralized fulfillment between two existing DCs

d) Cost parameters on centralized fulfillment

The following assumptions are used in assessing the impact of centralized fulfillment on profitability. The profitability analysis will be fed into the ROI analysis which follows, which will examine various impacts on two distinct periods: the Pre-Development Period and the Operation Period. The Pre-Development Period is the time needed for planning, design and approval of a new centralized FC. The Operation Period includes the time required for a facility to launch and for fulfillment to begin from the new facility, and usually starts one year after the investment is made (The Company, 2016). As shown in Table 38, the following costs will be impacted by centralization of fulfillment.

(1) Facility costs

In equipping an in-house fulfillment facility which has a minimum size of 280,000 sq. ft. and can pick, pack, and ship approximately 4,000–6,000 parcels per day, the investment cost depends on the location and the capacity. As shown in Figure 40, in-house centralized facilities can be expected to cost between $10 million and $70 million depending on the possibility of adding new features later. If the new FC is built in NS, it will be easier to expand in the future when market demand grows. If, instead, the DCs in ON and AB are repurposed, The Company can immediately leverage their proximity to existing stores.

(2) Inventory cost

In the case of investing in the new FC or engaging a 3PL company to fulfill from the current DC, the inventory would increase by about 50%, based on The Company's internal estimation. To maintain the same 99% fill rate, the annual inventory costs would rise from an average of average $80 million to $120 million. Assuming that once the online fulfillment facilities are added, this one-time inventory investment will be maintained to keep the same inventory level in the ten-year period which follows, this would be the new ongoing inventory level and cost.

(3) Shipping cost and handling cost

Centralized fulfillment has a positive impact on the shipping and handling costs per order for two reasons. First, it reduces the number of shipments per order, which saves shipping and

handlings costs from multiple picking and packing and multiple shipments. Second, it changes the proximity between the FC location and customers' delivery addresses, making the total expense for each order more predictable. Table 37 shows that the two lowest-cost options, in terms of shipping and handling, are the options of having two DCs (2DC) or one DC in Ontario (ON DC). Due to optimal location for split fulfillment, shipping from these two options yields the lowest shipping costs, an average of $7.6 (2DC) and $9.0 (ON DC) using Xpresspost and $13.0 (2DC) and $15.7 (ON DC) using Priority. The cost to ship with these two options is better than SFS with the virtual centralized FCs. The cells colored in red in Table 37 show a less than optimal shipping cost per order when shipped from AB and NS. A centralized FC in AB or NS would disadvantage The Company greatly as shipping from NS or AB is more costly than SFS: $14.9 (AB DC) and $14.7 (NS DC) using Xpresspost and $24.3 (AB DC) and $25.0 (NS DC) using Priority.

	SHIPPING COST ($)				TOTAL SC & HC ($)		
OPTIONS	Xpresspost	Priority	Purolator's Express	HANDLING COST ($)	Xpresspost	Priority	Purolator's Express
SFS	9.5	16.2	29.4	4.8	14.3	21.0	34.2
2DC	7.6	13.0	22.6	2.9	10.6	15.9	25.5
ON DC	9.0	15.7	22.6	2.9	12.0	18.6	25.5
AB FC	12.0	21.4	22.6	2.9	14.9	24.3	25.5
NS FC	11.7	22.1	22.6	2.9	14.7	25.0	25.5

Table 37: Average shipping and handling cost per order comparison

Table 38 below details the variables needed to calculate profitability from the scenarios in the ROI sensitivity analysis (industry growth rate, cost of investing in two new FCs, and cost of using Xpresspost delivery service). Table 38 also shows the variables and assumptions used in preparing the investment's cash flows and in calculating the Net Present Value (NPV) over the ten-year investment horizon starting in 2017. The ROI analysis is conducted based on the application of net present value (NPV) as demonstrated below in evaluating new project's cash flow (Innovation Science and Economic Development Canada, 2016).

$$\text{NPV (i, n)} = \sum_{t=0}^{n} \frac{R^t}{(1+i)^t}$$

Where:

t – the time of the cash flow,

i – the discount rate,

R – the net cash flow. In this study, there are three types of net cash flows: the investment cost (outflow), the net profit from operation (inflow), and the one-time inventory cost for the set-up of centralized facilities (outflow).

CLASSIFICATION	NO.	VARIABLE	DETAIL	VALUES
Operation Period	1	Average order value ($)	Using order value in Mar'16 as the average order value in the coming years	**$106**
Operation Period	2	Number of order (quantities)	The calculated number of orders based on one of the two projected growth rates	**99,960 orders**
Operation Period	3	Online revenue ($)	The product of the average order value and number of order 10,580,162.	**(1)*(2)**
Operation Period	4	Average shipping charge ($)	Calculated based on the order value and the shipping thresholds of 99$	**$4.14**
Operation Period	5	Shipping revenue ($)	The product of the average order value and number of order 10,580,162	**(2)*(4)**
Operation Period	6	Cost of goods sold (COGS) ($)	Based on the company cost structure: 48% Revenue	**48% x (5)**
Operation Period	7	Selling, General &Administrative Expenses (SGAE) ($)	Based on the company cost structure: 18% of online sales revenue	**18% x (5)**
Operation Period	8	Shipping Cost & Handling Cost (SC&HC) ($)	Based on the choice of service level from Canada Post: Xpresspost or Priority.	**14.7**
Operation Period	9	Gross online profit ($)	Deduct COGS, SGAE, and SC&HC from online revenue and shipping revenue. The profit varies for each scenario based on demand growth rate and SC&HC	**(3)+(5)-(6)-(7)-(8)**
Operation Period	10	Corporate tax rate	Based on the applicable tax rate for Canadian corporates in 2016 (KPMG, 2016)	**28%**
Operation Period	11	Net profit	Calculated based on the Gross online profit and the Corporate tax rate	**(9)x(10)**
Operation Period	12	Increased inventory cost vs. the current level that currently cost $80 million (%)	Based on The Company's projection of service level and inventory level. An increase of 50% value vs. current level for online sales at store	**50% x ($80 million)**
Pre-development Period	13	Investment cost	Estimated based on the cost to build a new FC in 2 DC	**$70 million**
Pre-development Period and Operation Period	14	Net cash flow R	For a standard project, in which cash outflows occur in early years and cash inflows in later years.	**Sequence of cash flow based on (11), (12), and (13),**
Investment cost items	15	Discount Rate i	Based on the suggested rate by CBRE (2016) on industrial real estate investment	**8%**
Investment cost items	16	Net Present Value	A project with a positive NPV means that investment makes economic sense, and the negative value means a loss on the investment (Amy, 2014).	**Based on (14)**

Table 38: Variables and assumptions to calculate profitability, the investment's cash flows, and the NPVs

Figure 42 plots the basic components for calculating the annual net profit of the above scenario (two centralized FCs in two existing DCs using Xpresspost under the industry growth rate). The average value related to order value (1), average shipping charge based on the conditional free shipping policy (4), average handling cost and shipping cost (8) are extracted from the calculation based on the data of the three-month sample. The Cost of Goods Sold, the Selling, General and Administrative Expenses, and the corporate tax rate as percentage of sales revenue are cost structures based on The Company's Profit and Loss statement. The Discount Rate (15) and the Net Present Value (16) are the investment cost items. In the first year of operation, which is shown in Figure 42, the investment cost of $70 million is not included. The orange bars show all the cost components that determine the final net profit. In this particular analysis, the net cash flow for the first year of operating the 2DC is presented for demonstration purpose.

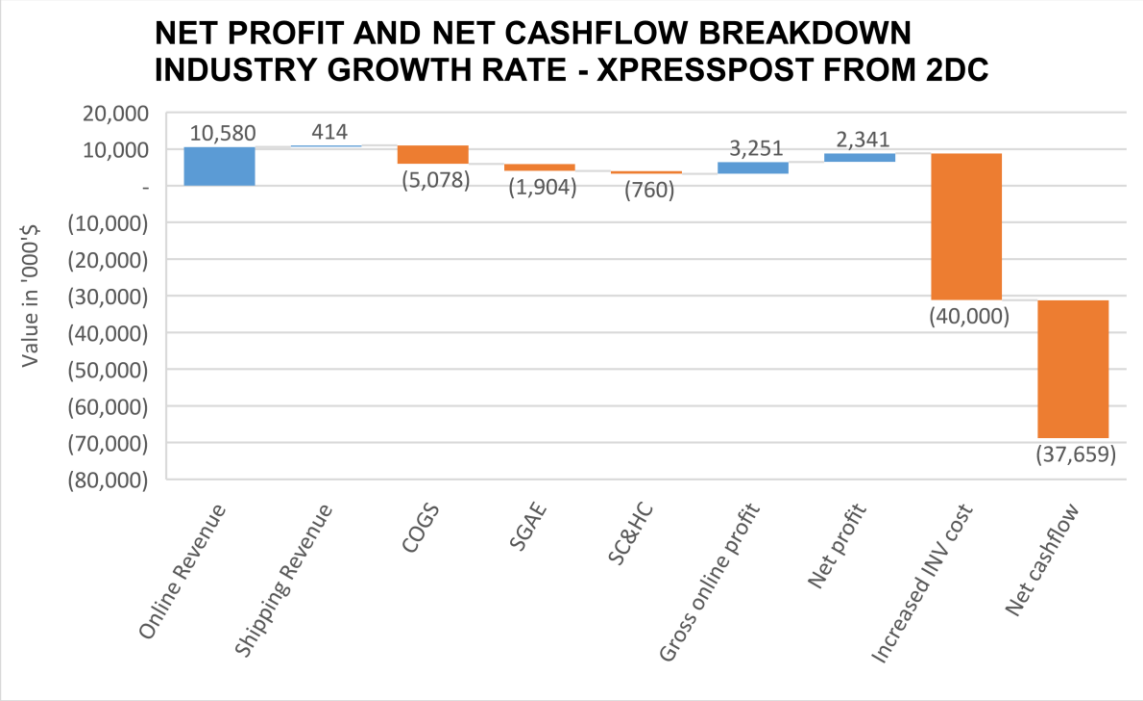


Figure 42: Net profit and net cash flow breakdown

e) Profitability

Table 39 to Table 42 show detailed ROI calculations in all eight scenarios summarized in Table 37. The first row indicates the scenario assumptions about: 1) the demand growth rate, industry growth rate or internal growth rate; 2) the shipping costs per order, Canada Post's Xpresspost or Priority. The second row calculates the online revenue based on the average order value. The third row calculates the shipping revenue based on the shipping charge.

The following rows are the calculated cost items to be deducted from revenue from gross online profit: Cost of Goods Sold (COGS) and Selling, General &Administrative Expenses (SGAE). In each fulfillment option, the Shipping Cost & Handling Cost (SC&HC) is stated in the row indicating the FC location. Net profit is calculated from gross online profit and the corporate tax rate. Inventory cost for the first year of operation and facility cost are investment items used to determine the net cash outflow on a yearly basis. The calculation of NPV (16) is based on the net cash flow for each year of operation starting from year 0 (2016), when the investment starts.

Industry growth rate		XPRESSPOST									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2. Number of order	84,000	99,960	117,405	135,540	141,399	162,184	186,025	213,371	244,737	280,713	321,978
3. Online Revenue ($ '000')		10,580	12,427	14,346	14,966	17,166	19,690	22,584	25,904	29,712	34,079
5. Shipping Revenue ($ '000')		414	486	561	585	671	770	883	1,013	1,162	1,333
6. COGS ($ '000')		(5,078)	(5,965)	(6,886)	(7,184)	(8,240)	(9,451)	(10,840)	(12,434)	(14,262)	(16,358)
7. SGAE ($ '000')		(1,904)	(2,237)	(2,582)	(2,694)	(3,090)	(3,544)	(4,065)	(4,663)	(5,348)	(6,134)
Option 2: Repurposing 2DC				8. SC&HC	10.6					16. NPV ($ '000')	(36,453)
8. SC&HC ($ '000')		(1,060)	(1,244)	(1,437)	(1,499)	(1,719)	(1,972)	(2,262)	(2,594)	(2,976)	(3,413)
9. Gross online profit ($ '000')		2,951	3,467	4,002	4,175	4,789	5,493	6,300	7,226	8,288	9,507
11. Net profit ($ '000')		2,125	2,496	2,881	3,006	3,448	3,955	4,536	5,203	5,968	6,845
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(25,000)										
14. Net cashflow ($ '000')	(25,000)	(37,875)	2,496	2,881	3,006	3,448	3,955	4,536	5,203	5,968	6,845
Option 3: Repurposing ON DC				8. SC&HC	12.0					16. NPV ($ '000')	(22,674)
8. SC&HC ($ '000')		(1,200)	(1,409)	(1,626)	(1,697)	(1,946)	(2,232)	(2,560)	(2,937)	(3,369)	(3,864)
9. Gross online profit ($ '000')		2,812	3,302	3,812	3,977	4,562	5,232	6,001	6,884	7,895	9,056
11. Net profit ($ '000')		2,024	2,378	2,745	2,863	3,284	3,767	4,321	4,956	5,685	6,520
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(10,000)										
14. Net cashflow ($ '000')	(10,000)	(37,976)	2,378	2,745	2,863	3,284	3,767	4,321	4,956	5,685	6,520

Table 39: ROI calculation under the industry growth rate - shipping service by Xpresspost

Industry growth rate		Priority									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2. Number of order	84,000	99,960	117,405	135,540	141,399	162,184	186,025	213,371	244,737	280,713	321,978
3. Online Revenue ($ '000')		10,580	12,427	14,346	14,966	17,166	19,690	22,584	25,904	29,712	34,079
5. Shipping Revenue ($ '000')		414	486	561	585	671	770	883	1,013	1,162	1,333
6. COGS ($ '000')		(5,078)	(5,965)	(6,886)	(7,184)	(8,240)	(9,451)	(10,840)	(12,434)	(14,262)	(16,358)
7. SGAE ($ '000')		(1,904)	(2,237)	(2,582)	(2,694)	(3,090)	(3,544)	(4,065)	(4,663)	(5,348)	(6,134)
Option 2: Repurposing 2DC				8. SC&HC	15.9					16. NPV ($ '000')	(41,076)
8. SC&HC ($ '000')		(1,589)	(1,867)	(2,155)	(2,248)	(2,579)	(2,958)	(3,393)	(3,891)	(4,463)	(5,119)
9. Gross online profit ($ '000')		2,422	2,844	3,284	3,426	3,929	4,507	5,169	5,929	6,801	7,800
11. Net profit ($ '000')		1,744	2,048	2,364	2,466	2,829	3,245	3,722	4,269	4,896	5,616
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(25,000)										
14. Net cashflow ($ '000')	(25,000)	(38,256)	2,048	2,364	2,466	2,829	3,245	3,722	4,269	4,896	5,616
Option 3: Repurposing ON DC				8. SC&HC	18.6					16. NPV ($ '000')	(28,432)
8. SC&HC ($ '000')		(1,859)	(2,184)	(2,521)	(2,630)	(3,017)	(3,460)	(3,969)	(4,552)	(5,221)	(5,989)
9. Gross online profit ($ '000')		2,152	2,527	2,918	3,044	3,491	4,004	4,593	5,268	6,043	6,931
11. Net profit ($ '000')		1,549	1,820	2,101	2,192	2,514	2,883	3,307	3,793	4,351	4,990
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(10,000)										
14. Net cashflow ($ '000')	(10,000)	(38,451)	1,820	2,101	2,192	2,514	2,883	3,307	3,793	4,351	4,990

Table 40: ROI calculation under the industry growth rate - shipping service by Priority

Internal growth rate		XPRESSPOST									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2. Number of order	84,000	134,400	193,536	294,175	420,670	521,631	599,875	659,863	725,849	798,434	878,277
3. Online Revenue ($ '000')		14,225	20,485	31,137	44,525	55,211	63,493	69,842	76,827	84,509	92,960
5. Shipping Revenue ($ '000')		556	801	1,218	1,741	2,159	2,483	2,732	3,005	3,305	3,636
6. COGS ($ '000')		(6,828)	(9,833)	(14,946)	(21,372)	(26,501)	(30,477)	(33,524)	(36,877)	(40,565)	(44,621)
7. SGAE ($ '000')		(2,561)	(3,687)	(5,605)	(8,015)	(9,938)	(11,429)	(12,572)	(13,829)	(15,212)	(16,733)
Option 2: Repurposing 2DC				8. SC&HC	10.6				16. NPV ($ '000')		6,747
8. SC&HC ($ '000')		(1,425)	(2,051)	(3,118)	(4,459)	(5,529)	(6,359)	(6,995)	(7,694)	(8,463)	(9,310)
9. Gross online profit ($ '000')		3,968	5,714	8,686	12,421	15,402	17,712	19,483	21,432	23,575	25,932
11. Net profit ($ '000')		2,857	4,114	6,254	8,943	11,089	12,753	14,028	15,431	16,974	18,671
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(25,000)										
14. Net cashflow ($ '000')	(25,000)	(37,143)	4,114	6,254	8,943	11,089	12,753	14,028	15,431	16,974	18,671
Option 3: Repurposing ON DC				8. SC&HC	12.0				16. NPV ($ '000')		18,478
8. SC&HC ($ '000')		(1,613)	(2,322)	(3,530)	(5,048)	(6,260)	(7,199)	(7,918)	(8,710)	(9,581)	(10,539)
9. Gross online profit ($ '000')		3,780	5,443	8,274	11,832	14,672	16,872	18,560	20,416	22,457	24,703
11. Net profit ($ '000')		2,722	3,919	5,957	8,519	10,564	12,148	13,363	14,699	16,169	17,786
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(10,000)										
14. Net cashflow ($ '000')	(10,000)	(37,278)	3,919	5,957	8,519	10,564	12,148	13,363	14,699	16,169	17,786

Table 41: ROI calculation under the internal growth rate - shipping service by Xpresspost

Internal growth rate		Priority									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2. Number of order	84,000	134,400	193,536	294,175	420,670	521,631	599,875	659,863	725,849	798,434	878,277
3. Online Revenue ($ '000')		14,225	20,485	31,137	44,525	55,211	63,493	69,842	76,827	84,509	92,960
5. Shipping Revenue ($ '000')		556	801	1,218	1,741	2,159	2,483	2,732	3,005	3,305	3,636
6. COGS ($ '000')		(6,828)	(9,833)	(14,946)	(21,372)	(26,501)	(30,477)	(33,524)	(36,877)	(40,565)	(44,621)
7. SGAE ($ '000')		(2,561)	(3,687)	(5,605)	(8,015)	(9,938)	(11,429)	(12,572)	(13,829)	(15,212)	(16,733)
Option 2: Repurposing 2DC				8. SC&HC	$ 15.90				16. NPV ($ '000')		(5,630)
8. SC&HC ($ '000')		(2,137)	(3,077)	(4,677)	(6,689)	(8,294)	(9,538)	(10,492)	(11,541)	(12,695)	(13,965)
9. Gross online profit ($ '000')		3,256	4,689	7,127	10,191	12,637	14,533	15,986	17,585	19,343	21,278
11. Net profit ($ '000')		2,344	3,376	5,131	7,338	9,099	10,464	11,510	12,661	13,927	15,320
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(25,000)										
14. Net cashflow ($ '000')	(25,000)	(37,656)	3,376	5,131	7,338	9,099	10,464	11,510	12,661	13,927	15,320
Option 3: Repurposing ON DC				8. SC&HC	18.6				16. NPV ($ '000')		3,064
8. SC&HC ($ '000')		(2,500)	(3,600)	(5,472)	(7,824)	(9,702)	(11,158)	(12,273)	(13,501)	(14,851)	(16,336)
9. Gross online profit ($ '000')		2,893	4,166	6,333	9,056	11,229	12,913	14,205	15,625	17,187	18,906
11. Net profit ($ '000')		2,083	3,000	4,559	6,520	8,085	9,297	10,227	11,250	12,375	13,612
12. Increased INV ($ '000')		(40,000)									
13. Investment cost ($ '000')	(10,000)										
14. Net cashflow ($ '000')	(10,000)	(37,917)	3,000	4,559	6,520	8,085	9,297	10,227	11,250	12,375	13,612

Table 42: ROI calculation under the internal growth rate - shipping service by Priority

The NPV options marked with green dots are the financially feasible ones if respective demand growth is as estimated. In general, all of the centralized fulfillment options under the moderate growth rate (Table 39 and Table 40) estimated by Euromonitor (2015), described in section IV.B.1 – Demand Growth Assumption, are not predicted to return a positive NPV. The red dots indicate the non-positive ROI. Due to insufficient demand, the high value of investment into the facility and the costly first-time centralized inventory investment, the predicted net profit from operation is not sufficient to offset it. Among all the unfeasible scenarios, investing in upgrading the ON DC and using Xpresspost seems to yield the least loss, $20.06 million, whereas shipping by Priority from the ON DC would incur a loss of $25.9 million. This analysis also supports the

fact that the more investment is spent on building a new centralized FC, the lower the NPV would be. The ON DC which will cost $10 million to repurpose for centralization is the less costly investment among the two feasible options.

Both Tables Table 41 and Table 42 indicate the top choices of investment based on NPV calculation under the high demand growth rate: 1) When using Xpresspost: ON DC ($18.48 million), 2DC ($6.75 million); 2) in using Priority: ON DC ($3.07 million). This analysis also supports the fact that the lower the shipping cost, the higher the chance that the options would have a positive NPV, as demonstrated in the case of repurposing the 2DCs for split shipment, where the higher shipping cost option (Priority) yields a lower ROI of $12.4 million compared to using Xpresspost. The role of demand growth is also emphasized in the ROI calculation results. The minimum required demand for centralized fulfillment to yield a profitable ROI is closest to that assumed in the high growth rate scenario where the NPV is positive.

f) Shipping time

Table 43: Average shipping time - SFS, 2DC, and ON DC below summarizes the average shipping time of an average order from the fulfillment locations to the customers' province/territory using Xpresspost or Priority. The shipping time data supports locating the centralized FC in 2 current DCs concurrently. SFS has relatively better shipping times than shipping from one unique DC in ON. The shipping times for an average parcel delivered by Xpresspost from any of the two DCs ranges from 1.38 days to 3.11 days. Similarly, those of similar dimensions that are shipped by Priority have similar shipping times for major urban areas (AB, BC, and ON). The difference in shipping time between the two services from the same fulfillment location is one day for customers in MB and Atlantic.

	Option for FC	CUSTOMER PROVINCE											
		AB	BC	MB	NB	NL	NS	ON	PE	QC	SK	YT	Average
Xpresspost	2DC	1.38	1.44	2.45	2.56	2.77	2.69	1.51	2.59	2.06	1.50	3.11	1.72
	ON	2.38	2.37	2.45	2.56	2.77	2.69	1.51	2.59	2.06	2.61	3.11	2.00
	SFS	1.84	1.91	1.87	2.12	2.24	2.12	1.74	2.14	1.74	1.96	3.49	1.85
	Option	AB	BC	MB	NB	NL	NS	ON	PE	QC	SK	YT	Average
Priority	2DC	1.38	1.44	1.45	1.56	1.84	1.69	1.43	1.59	1.48	1.50	3.11	1.47
	ON	1.40	1.40	1.45	1.56	1.84	1.69	1.43	1.59	1.48	1.61	2.29	1.47
	SFS	1.62	1.66	1.64	1.74	1.95	1.71	1.58	1.82	1.57	1.75	3.27	1.64

Table 43: Average shipping time - SFS, 2DC, and ON DC

Data suggest that fulfillment time can be delayed by both the standard deviations of pick-and-pack time and by the shipping time. This possible delay might impact the shipping services. Table 44 shows the total fulfillment days, taking the standard deviations of pick-and-pack time and shipping time into account. Because operations at the centralized facility are automated and more productive than operations at stores, it is assumed that the standard deviation for centralized operations is much lower than that of SFS using any of the service in consideration.

FULFILLMENT CHOICE	FULFILLMENT TIME		
	CEP	MEAN	STD DEV
SFS	Xpresspost	3.81	2.17
	Priority	3.60	2.12
	Purolator	2.96	2.01
2FC	Xpresspost	2.74	0.76
	Priority	2.49	0.63
ON	Xpresspost	3.01	0.77
	Priority	2.49	0.64

Table 44: Average fulfillment time using Xpresspost and Priority service- SFS, 2DC and ON DC

In general, SFS has certain advantages for fulfillment given the wide network of stores which allows nearly optimal shipping time compared to centralized FCs. However, due to the large variance of pick-and-pack time, total fulfillment time with SFS might be less optimal for increasingly large online sales.

V. CONCLUSION

A. Recommendation

This study evaluates alternative online fulfillment designs and compares decentralized fulfillment (SFS) to centralized fulfillment. The Company discussed in this study has the option to centralize online fulfillment from two current DCs (Ontario, Alberta or both) or build one new FC for online sales in Ontario, Alberta or Nova Scotia. The Company could use Purolator's Express, Canada Post's Xpresspost or Priority, or some combination, and charge the customer the current flat-rate or apply a conditional free shipping (CFS) policy at a threshold of $70.

The study also explores the current CEP's shipping fee charges and their impact on online fulfillment profitability. It then compares these impacts with those from contracting another CEP supplier to recommend an optimal parcel delivery service that supports financial and operational efficiency.

The study examines the available distribution network design options to test the impact of these potential changes on the company's profitability. The costs and benefits of each option for fulfillment and distribution are discussed. Numerous fulfillment approaches are available, ranging from centralized to decentralized online fulfillment with the presence of a 3PL partner providing CEP shipping services.

The move from the previous shipping fee charge to the current free shipping threshold, and its influence on shoppers' order incidence and order value density, is shown to increase online fulfillment profitability. The study proposes several possible solutions to the new and dynamic problems faced by the retailer in the study, including the heuristics of selecting centralization based on the NPV method.

1. ORDER VALUE DENSITY AND PROFITABILITY

In evaluating the influence of CEP service, the study finds the relationships between order value density variables and profitability variables. The data on March's online sales

show that there are shoppers who seek to save on shipping cost by spending more on orders, and those who do not choose to increase their expenditure. In general, the former group's behavior helps to increase average order value and brings up average profit per order. The impact of various shipping threshold quantities on profitability is not assessed in this study due to limited data on consumer behavior.

2. CHANGE OF CEP SERVICE PROVIDERS

In evaluating how CEP service impacts profitability, the analysis suggests that The Company could outperform its current financial performance by selecting a less costly shipping company. By not using a premium service, the switch from Purolator's Express to CEP services from Canada Post lowers shipping costs in the current demand scale, and this option is sustainable for a higher growth rate of demand. The profitability analysis supports this. Due to the influence of shipping cost on online fulfillment's profitability, the choice of CEP service providers largely determines the profitability of The Company. In changing the CEP service provider for SFS, the performance is more cost efficient and has better lead-time for shipping. Cost per order, shipping time, pick-and-pack time and total fulfillment time are presented for various CEP shipping service providers and for each FC approach.

However, this move requires the company to re-train its store staff in the new process, input new data for the whole product portfolio regarding shipping dimensions (weight and size), and invest in new IT systems for shipping automation at the store. This change would potentially limit the number of stores offering SFS for the sake of efficiency of shipping services. In lowering its shipping costs, The Company could also lower shipping charges to customers to be more competitive with competing retailers in the same market segment who provide a more "affordable shipping threshold" of $50 order value (Aldo, 2016; MEC, 2016; Sephora, 2016).

3. CHANGE FROM DECENTRALIZED FULFILLMENT TO CENTRALIZED FULFILLMENT

Centralized fulfillment is aimed at optimizing the FC location to reduce shipping and handling costs. The consolidation of fulfillment for high-demand products helps to better control stock availability, have more accurate inventory visibility in both peak and non-peak time, and increase fill rate. Fewer shipments per order mean less receipt due to lower number of parcels received by the customers, higher service level and lower shipping cost for The Company.

Considering the inventory mismatch between the stores' and central system's inventories, a centralized FC solves some of these problems thanks to real-time centralized inventory instead of virtually centralized inventory. When the number of orders increases with total online demand, centralizing online fulfillment will reduce unproductivity of unautomated pick-and-pack operations done in stores. Integrated DCs eliminate the downsides of a dedicated online FC, including gaps between the inventory allocated to fulfill online orders and allocated to BAM stores. This means more satisfaction, enhanced lead time and potentially more sales and profit for online sales.

The location of origin of customers' orders determines the optimum location to have a centralized fulfillment facility. The two most optimal locations available are chosen based on the lowest shipping rates from Xpresspost and Priority, in order to reduce the significant cost of transportation. However, in evaluating various distribution network options for more profitability and better ROI, there are various feasible options.

The repurposing of existing DCs to become online FCs might be the most cost-effective due to the possibility of leveraging current IT infrastructure for less costly facility and inventory management. Analysis shows that investing a large amount of fixed cost into a dedicated distribution network for its small online business might yield a poor ROI. Consequently, investment in a centralized online FC would be justified only if online sales grow strongly. Profitability analysis supports splitting online fulfillment by region to save

on shipping cost, with Ontario's DC in the most favorable location. The concentration of demand also plays an important factor in favoring those FCs in Eastern areas.

The cost of shipping from Alberta is evidence of the disadvantages of locating a consolidated facility for Canada-wide demand here. Given the slightly higher cost of shipping from this DC and lower demand concentration in the West, it would be less advantageous to integrate online fulfillment from a Western-area DC.

Based on the profitability sensitivity analysis for the current year, in replacing Purolator, The Company's SFS approach shows almost optimal shipping cost comparing to the proposed approached of fulfilling from the existing DCs (Table 37). Additionally, SFS offers some advantages given the current demand level. Firstly, separate fulfillment facilities would require separate inventory, increasing both fulfillment and inventory costs. Secondly, the company has an unpredictable demand and small concentrations of SKUs per order, where the 30 most ordered SKUs account for only 3.5 % of total quantities of SKUs ordered. Current E-commerce sales account for less than 2% of The Company's total channel sales. Thus, despite the percentage of loss from online sales due to high shipping cost, the absolute amount of this loss is minimal relative to the sales portion for The Company. At the current fulfillment volume, the current fulfillment option, which uses the store network as a virtually centralized warehouse, is adequate.

In the longer term, SFS poses important challenges to fulfilment capacity and service performance. SFS allows store customers to have priority over online orders which causes the relatively lower fill rate for promotional products. This challenge is emphasized when the ordering speed of promotional SKUs (the "door-crashers") from the online channel increases. The slow update of store inventory and the low speed of order pick-up by store staff make a virtual centralized FC less optimal than an actual centralized FC.

At some point, SFS will no longer be practically feasible due to the high volume of orders to fulfill. Current store layouts, store space, and store staff are not optimal for a high speed of operation. Many areas of store-based fulfillment would not yield the optimal cost

and service level when demand changes demographically or in scale. For example, the inventory pooling effect would no longer yield profit when multi-shipment costs more than it currently does. Or, if one region increases its demand by ten to twenty times, SFS would not leave local stores with inventory available to fulfill orders in time; inventory would then need to be shipped regionally or nationally. These cases, if they materialise, will cause SFS to lose the current advantage of local and regional transportation rates. The resulting lower service performance will reduce customer satisfaction, which potentially translates to loss of future sales.

Before the demand changes sufficiently to justify centralization, The Company still needs to accommodate small incremental increases in demand. This transition can be done by implementing store fulfillment capabilities such as state-of-art virtual warehousing inventory management and picking equipment to increase fulfillment capacity. However, there is evidence of important downsides of SFS. Its success depends on: 1) stock availability at local stores; 2) store willingness and ability to fulfill; 3) infrastructure for pooled inventory. The Company has a third option of outsourcing fulfillment from its centralized FC to a 3PL. This process will cost more to fulfill per individual order but save the immediate investment cost. This option removes certain benefits of in-house online fulfillment, such as having more visibility for fulfillment steps in the middle (e.g. pick-and-pack) as well as the ability to upgrade fulfillment technology used by the 3PL.

In general, store fulfillment, the middle ground for small sales volume, still appears to be the most profitable options for the next few years given the expected slow rise in volume of orders from the online channel, until online demand grows significantly. Investing in a new dedicated online FC in a new market will cost between 30$ million and $80 million; the volume of sales that will justify that investment is approximately at least three times the current one.

B. Limitations and suggestions for future research

This study assumes that stock holding does not increase with the switch from decentralized distribution to centralized distribution for online sales. Given the importance of inventory cost in the strategic decisions of distribution, it is necessary to assess the change in this variable in profitability when considering the efficiency of the switch from a decentralized to a centralized system while maintaining the current service level in terms of fill rate. This presents some important unknowns, such as how much inventory holding changes and how much this change costs. Thus, the findings and conclusions in this study might not take into account important variables.

There is limited data on the effects of changes of shipping threshold level on revenue and how higher shipping threshold reduces customer satisfaction and profitability. The benefits of switching from the current $70 to $50 like other retailers in the same segments are not established. There is a lack of supporting data and evidence of positive impacts on revenue and profit to favor this switch.

The analysis of ROI is not sufficiently rigorous at the level of corporate finance to give the most realistic estimate of profitable return for each option. A comprehensive model of ROI must take into account more factors than this study's simple cash inflow, outflow and discount rate. Lack of data related to inventory cost also makes the profit calculation and ROI analysis less accurate.

For future research, more observation of similar practices and their implications for Canadian retailing across time are needed. For example, a more extensive study of how online fulfillment operations vary between The Company and other multi-channel retailers, in terms of optimal allocation and routing of orders, would advance our understanding of these complex variables. This will give more clarity on the current low fill rate for particular periods and certain products in light of the order accepting window for online transactions. The study has not linked the shopper's order incidence with profitability.

This thesis also invites operations researchers to study the correlations between distribution network, fulfillment choices, inventory level changes and companies' performance in terms of profit margin and service level.

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VII. APPENDIX

DC TYPE	KEY CHARACTERISTICS	EXTERNAL INFRASTRUCTURE	INTERNAL INFRASTRUCTURE
Traditional DC	High cubic volume buildings that facilitate the movement of bulk products from manufacturers to stores or consumers Increasingly large (300,000 SF to l Million SF) Located in urban fringe areas, with good highway accessibility and multiple access points from major roads Cross-docking preferable Single or multi-tenanted Spec or BTS Leased	Large, deep trailer courts for manoeuvring Multiple dock loading doors (minimum 1 trailer space per door or per 4,000 SF, but higher the better) Secured sites (fencing, security) 32' minimum clear height, although 36'and 40' are becoming more in demand	High floor load capacity (both live load and point load) Wide-column spacing High racking systems
Online fulfillment Centre	High cubic volume buildings designed for unit picking of individual goods Large labour pool of permanent and seasonal workers Very large (500,000 SF to l Million SF) Located in urban fringe areas, with good highway access and in proximity to multi-modal and integrator (FedEx, Purolator's Express, UPS) hubs Single tenanted, usually BTS Leased, although sometimes owner occupied	Large, deep trailer courts for manoeuvring Multiple dock loading doors (minimum 1 trailer space per door or per 4,000 SF, but higher the better) Large surface parking for cars Secured sites (fencing, security) 32' minimum clear height, although 36' and 40' becoming more in demand	High floor load capacity Large office/mezzanine build-outs, sometimes in multiple levels Customized sorting machinery in some cases Shelving for smaller products Heavy power redundancy Some automation of picking and sorting systems
FOOD DISTRIBUTION	Buildings that facilitate the movement of bulk products from manufacturers to stores Varied size (20,000 SF to 400,000 SF) Located in urban fringe areas, with good highway accessibility and multiple access points from major roads Single or multi-tenanted Spec or BTS Leased	Multiple dock loading doors with dock seals	Roof and building insulation Refrigeration facilities and chilling equipment

Table 45: Comparison of various key features of distribution facilities (GWL, 2014)

Men's clothes

Item	Weight in grams	Item	Weight in grams
Underpants	70 - 100	Jacket	1000 - 1200
Sports shirt, T-shirt	220 - 300	Coat, duster	900 - 1500
Shirt	120 - 180	Wind-breaker	800 - 1200
Business suit	1200 - 1800	Autumn jacket	1200 - 1400
Sports suit	1000 - 1300	Winter jacket	1400 - 1800
Pants	600 - 700	Fur coat	3000 - 8000
Jeans	650 - 800	Hat	60 - 150
Shorts	250 - 350	Scarf	90 - 250
Jersey	450 - 600	Gloves	80 - 140
Hoodie	270 - 400		

Men's footwear

Item	Weight in grams	Item	Weight in grams
Slippers	250 - 500	Boots	1000 - 1400
Sandals	400 - 600	High boots	1400 - 1800
Running shoes, moccasins	700 - 800	Gumboots	1000 - 1400
Shoes	700 - 850		

Women's clothes			
Item	**Weight in grams**	**Item**	**Weight in grams**
Underpants	15 - 30	Shorts	150 - 250
Bra	40 - 70	Skirt	200 - 300
Swimming suit	90 - 120	Sweater	300 - 400
Tube top	70 - 85	Hoodie	400 - 500
T-shirt	100 - 140	Jacket	230 - 400
Shirt	100 - 250	Coat	600 - 900
Dress	120 - 350	Wind-breaker	400 - 600
Evening dress	120 - 500	Autumn jacket	600 - 800
Wedding dress	800 - 2000	Winter jacket	800 - 1000
Business suit	800 - 950	Fur coat	3000 - 4000
Sports suit	650 - 750	Hat	60 - 120
Pants	300 - 400	Scarf	90 - 150
Leggings	260 - 300	Gloves	40 - 100

Women's footwear			
Item	**Weight in grams**	**Item**	**Weight in grams**
Slippers	200 - 350	Boots	800 - 1200
Sandals	400 - 600	High boots	800 - 1300
Running shoes, moccasins	600 - 700	Gumboots	800 - 1000
Shoes	500 - 650		

Table 46: Weight assumption by product (Shopozz, 2016)

% constant value growth, retail value rsp excl sales tax

	2014/2015	2014-19 CAGR	2014/19 TOTAL
Apparel and Footwear	4.3	14.7	98.4
Beauty and Personal Care	3.4	1.7	9.0
Consumer Appliances	3.9	4.2	22.7
Consumer Electronics	5.8	4.3	23.7
Consumer Healthcare	5.4	5.4	30.0
Food and Drink	3.3	3.7	20.0
Home Care	5.6	10.2	62.7
Home Improvement and Gardening	17.1	13.3	87.0
Housewares and Home Furnishings	4.2	4.1	22.0
Media Products	10.3	10.7	66.0
Personal Accessories and Eyewear	5.4	6.4	36.6
Pet Care	6.3	17.8	126.8
Traditional Toys and Games	3.6	5.6	31.1
Video Games Hardware	0.6	1.4	7.1
Other Internet Retailing	19.4	17.8	127.1
Internet Retailing	10.4	11.5	72.1

Source: Euromonitor International from trade associations, trade press, company research, trade interviews, trade sources
Note: Forecast value data in constant terms.

Table 47: Internet retailing forecasts by category: % value growth 2014-2019 (Euromonitor, 2015)