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THE IMPACT OF RETAILER'S CENTRALIZED PURCHASING STRUCTURE ON VENDOR ORDER FULFILLMENT: A CASE STUDY ANALYSIS

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THE IMPACT OF RETAILER'S CENTRALIZED PURCHASING STRUCTURE ON VENDOR ORDER FULFILLMENT: A CASE STUDY ANALYSIS

A Thesis Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Nayla Gwen Antypas
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ABSTRACT

To remain competitive in today's market and economy, retail companies must provide products and services in the form, time and place that their consumers demand. The rise in e-commerce and improved logistics capabilities have changed how products are sold. Companies are looking to decrease costs and lead times to remain profitable as competition and consumer demands intensify. Retailers are looking to lower costs in their supply chain. Using sales data and forecasting methods, retailers are placing smaller, more frequent orders to decrease inventory and associated inventory costs throughout their network. This faster replenishment model has led to small containers becoming more common in wholesale fulfillment than large containers.

Though there has been a shift in order size and frequency, there has been little change in ordering structure. Many major retailers use a centralized purchasing structure. Within the structure, there are different product categories, or departments, with buyers that place orders for the entire company. This allows for departmental expertise. Under this structure, employees from each buying department are placing multiple orders per week. This has a huge impact on vendors that supply products that fall into more than one retail category. Different orders cannot be combined so vendors could potentially receive multiple orders from the same customers that originated from different buying departments.

A case study on buying strategy and structure demonstrates that a change from current retailer ordering structure with multiple buying departments to a single source of orders can decrease vendor corrugate and labor costs by 16%. This change allows the vendor to deliver the same products while using less labor and packaging materials. A company's supply chain can be a competitive advantage for those that constantly evaluate their current systems and practices. The process of placing and fulfilling orders will remain an essential activity in the supply chain, so these processes and practices should be evaluated.

PREFACE

This study was completed in accordance with the requirements for completion of a Master of Science degree in Industrial Engineering from the University of Tennessee Tickle College of Engineering. The primary research and case study was completed in cooperation with external companies. The names of these companies have been removed from this report to protect their core competencies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE
INTRODUCTION AND GENERAL INFORMATION

Introduction

To remain competitive in today's market and economy, retail companies must provide innovative products and services in the form, time, and place that their consumers demand. Online shopping and e-commerce has completely changed how product and services are bought and sold. According to Deloitte's Holiday Survey, "when defining what constitutes "fast shipping", 54% of holiday shoppers said two days or less (Deloitte, 2017)." As delivery capabilities have changed, the interactions between buyers and suppliers within supply chains have changed as well. Advancements in technology and logistics have resulted in more transparent supply chains, more accurate data, improved data analytics capabilities, and better buyer-supplier communication between parties conducting business with one another.

Along with these supply chain advancements, there has been financial pressure on retail companies to decrease direct costs, indirect costs, and waste to maintain profitability as marketplace competition intensifies. One area in which companies are looking to lower costs is in supply chain and logistics. Many faster replenishment models have been adopted to reduce inventory and associated costs throughout the supply chain. Using sales data, forecasting methods, and consumer insights, the buyers at retail companies are placing smaller, more frequent orders to decrease the holding and storage costs of their inventory. This 'just-in-time' order replenishment model of higher frequency, low quantity orders has been adopted by many retail companies. This model almost resembles the e-commerce ordering patterns. Smaller and different sized cartons, also called boxes, are becoming more frequent in wholesale fulfillment than larger cartons. In essence, this rapid replenishment model has become a faster, smaller size ordering replenishment model. "Companies are moving faster to replenish their stores too, in order to keep less inventory at each location and cut inventory across the network," said Meller (2015). This replenishment model has increased retailer in-stock position to 97% while decreasing inventory by 25% (Meller, 2015). These improvements have both positively and negatively impacted different upstream fulfillment metrics. Every company in the retail industry needs to find a balance between satisfying consumers and decreasing supply chain costs without negatively impacting their upstream vendors

and suppliers. Although there has been a significant shift in order quantities and frequency, there has been little change or shift in the purchasing structure that is now being used by many major retail companies.

This supply chain challenge makes it relevant to assess the current centralized purchasing structure that many retail companies use and understand the impact of this on vendors and suppliers.

Purpose

Background and Motivation for Research

Motivation to conduct this research stemmed from the researcher's experience in supply chain, specifically in distribution centers. Being downstream from customer service and order management, distribution centers have limited visibility to the customers and consumers. Most orders are transmitted from a retail company to their vendors through EDI (Electronic Data Exchange), then orders are sent to the WMS (Warehouse Management System). Therefore, the information received in warehouse management system is not always transparent to the original order. This is often due to the settings and different capabilities in the ERP and WMS software. This area of study is one that can be developed as the retail industry, purchasing strategies, and fulfillment methods evolve in future years.

Thesis Objective

The objective of this project was to address the literature gap that exists regarding the impacts of the centralized purchasing structure on vendor order fulfillment. This study aimed to quantify this impact through a case study and research. It also aimed to make recommendations that could potentially minimize supply chain costs for both the buyers and suppliers, while also meeting and exceeding the demands of the consumer.

Hypothesis

It is likely that the applicability of the case study is dependent on each individual retail company and their business processes, however certain findings shall hold true.

The hypothesis was that centralized purchasing structures with multiple buying departments is more expensive for vendor order fulfillment, than consolidating all orders by their associated dates before placing them.

While vendors may see financial gain from retail companies implementing some of the recommendations made, it is important for companies to evaluate their current supplier relationships, their supply chain organization, and business capability before modifying their systems.

Project Scope

Scope of Work

This scope of work for this thesis project is restricted to providing conclusions about the topic supported by research and a case study application. The defined topic is 'studying the impact of retailer's centralized purchasing structure on vendor order fulfillment'. A retailer is defined as a company that falls into the department store, discount, or specialty retail categories. Retailers not included are supermarkets and warehouse retailers, it should be noted that much of the information presented might have a direct correlation. The scope of "centralized purchasing structure" is defined as the employee structure within a centralized purchasing department. This specific focus is due direct knowledge. This report includes a review of relevant literature, case study development, simulation formulation, results discussion, and formulation of recommendations.

For the purpose of this report, it is important to define the difference between a vendor and a supplier. The researcher differentiated these by recognizing that both vendors and suppliers provide goods or services, but a vendor can be used for both business-to-business (B2B) and business to consumer (B2C) where a supplier is used for solely B2B relationships (Hartwig, 2017). Throughout the document, the term 'vendor' was used although in many cases this term can be interchanged with the term 'supplier', depending on the specific application.

It is also important to indicate the difference between a fulfillment center and distribution center. A fulfillment center (FC) is a facility that normally fulfills their obligation to a consumer by sending a finished good. Amazon is a strong example of a company distributing goods using fulfillment centers. A distribution center (DC) is a facility that fulfills their obligation by sending finished goods to retail locations, wholesaler customers, or directly to customers (Reed &

Harmelink, 2013). Throughout this report the term 'distribution center', was used, though for some companies, the term 'fulfillment center' is more applicable.

The term 'order' is used through this report. From the perspective of a retail company this term is synonymous with a purchase order (PO). From the perspective of a vendor this term is synonymous with a Sales Order (SO).

Organization of Thesis

This thesis is organized in five different sections, titled chapters. The chapters are introduced by author acknowledgements, preface, abstract, table of contents, list of tables, and list of figures. The appendix, references, and vita can be found at the conclusion of the content chapters. The structure of the five content chapters are intended to provide general information, context about the project, a case study application, simulation development, results, and discussion.

The general information aims to provide context in which the thesis was written. The literature review includes a collection of the relevant literature and identifies the literature gap that exists on this topic. This literature review also looks at current business practices in place at retail companies. The project development section defines the research question, case study methodology, and simulation approach. Chapter four gives company background, outlines the data collection process, presents the data, discusses the assumptions made in the model, and presents the case study results. The conclusive chapter five summarizes the project, discusses potential best practices, and discusses areas for research development and improvement.

Validation of Thesis

Due to resource constraints, and lack of publicly available business data, the conclusions of this thesis were based on the research data and simulation results from the case study application. It should also be acknowledged that error and variability exist between modeling and realistic application due to assumptions made in the model. A model is, in essence, an imitation of a real-world system that does not account for all of the complexity in a system. The ideas, results, and recommendations presented in this thesis should be read and used if applicable to the company, rather than solely using the simulation model results.

List of Abbreviations and Acronyms

AR	Automatic Replenishment
DC	Distribution Center
E-Commerce	Electronic Commerce
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
FC	Fulfillment Center
KPI	Key Performance Indicator
MHE	Material Handling Equipment
POS	Point-of Sale
PO	Purchase Order
QR	Quick Response
SAP	Systems Application Products
SC	Supply Chain
SKU	Stock Keeping Unit
SO	Sales Order
VMI	Vendor Managed Inventory
WMS	Warehouse Management System

CHAPTER TWO
LITERATURE REVIEW

Background Information

    This literature review was completed to gain insights from the current research on the retail industry, order management, and retail purchasing structure. There are many other closely related topics and many different factors that contribute to the success of a retailer. Related topics were mentioned and discussed if their relevance to the hypothesis could be identified.

    Search terms and phrases included *ordering structure, retail industry, order management, fulfillment, retail fulfillment, purchase order, sales order, procurement, retail buyer, centralized purchasing, automatic replenishment, supply chain, distribution network, and decentralized purchasing*. The databases used were found through the University of Tennessee, Knoxville library databases.

Purchasing Methods

Purchasing Strategy: Centralized vs Decentralized

    Centralized purchasing is defined as having a single department responsible for purchasing for the entire organization. Larger companies often adopt a centralized purchasing strategy and have buyers reporting to a purchasing executive (Murray, 2017). These centralized purchasing departments are normally located at the head office or company headquarters. At a retail company, centralized purchasing would mean that this purchasing department places orders to be delivered to all of their stores. Retailers with a large number of different outlets prefer a centralized buying strategy and places their purchasing department at company headquarters (Juneja, 2015). This allows for other merchandising decisions to be made in cooperation with purchasing. This can also help develop stronger, more centralized relationships with vendors. Within the centralized purchasing department, there are often different buyers that deal with certain product categories and purchase product within these categories for all of their locations. Retail companies look for employees, buyers, and merchandisers that have product knowledge and expertise in order to enhance the customer experience (Suttle). These employees are placed in these product specific

departments to better understand consumer preferences and become experts on products and vendors.

Decentralized purchasing allows for each facility or group of facilities to carry out their own purchasing. This strategy often makes sense when there are significant differences in each facility. Decentralized purchasing is effective when there is a limited number of retail locations with smaller volumes.

There is also a combined buying strategy that centralizes much of the bulk purchasing but leaves the more specialized buying to the local retailers. Figure 1 illustrates centralized purchasing strategy and shows how one department places orders to their suppliers. Figure 2 illustrates decentralized purchasing strategy and shows how the purchasing function is assigned to each individual facility.
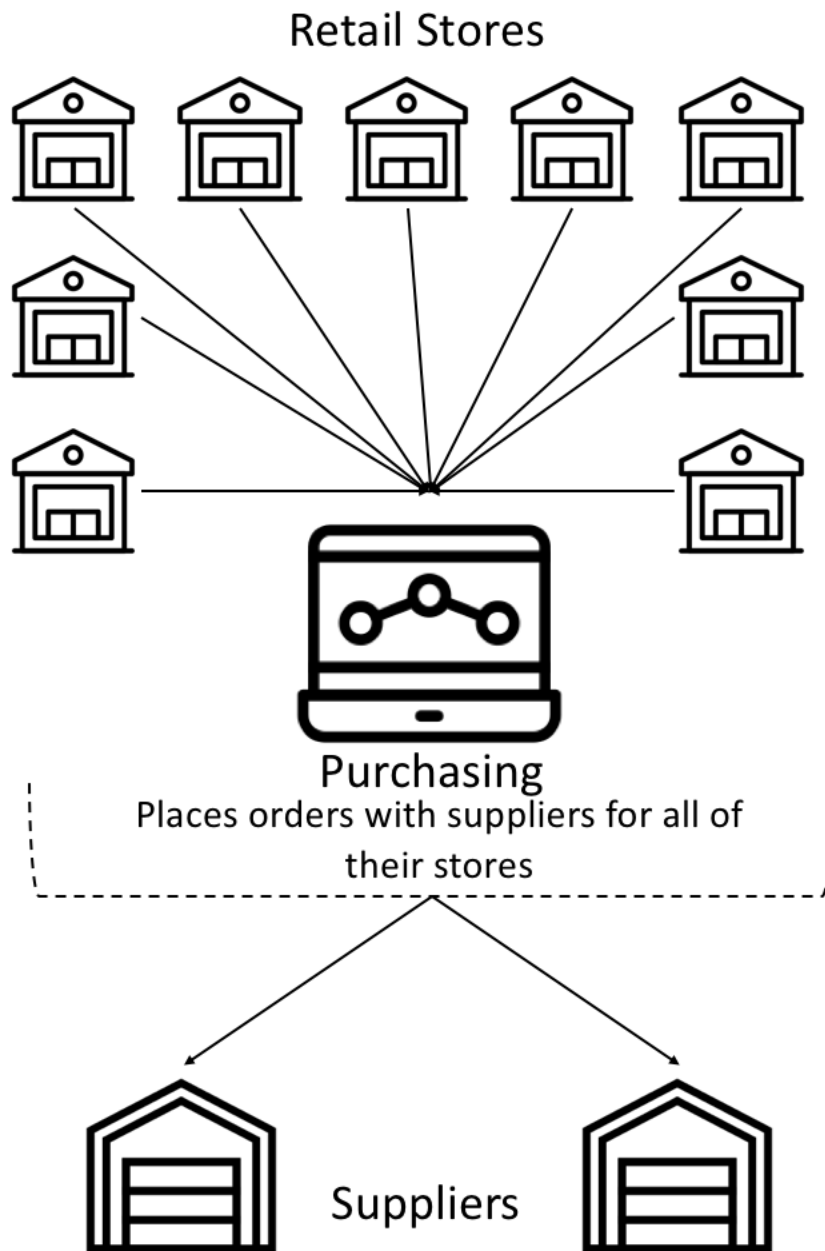
Figure 1: Centralized Purchasing

Each individual store places its own orders with the suppliers
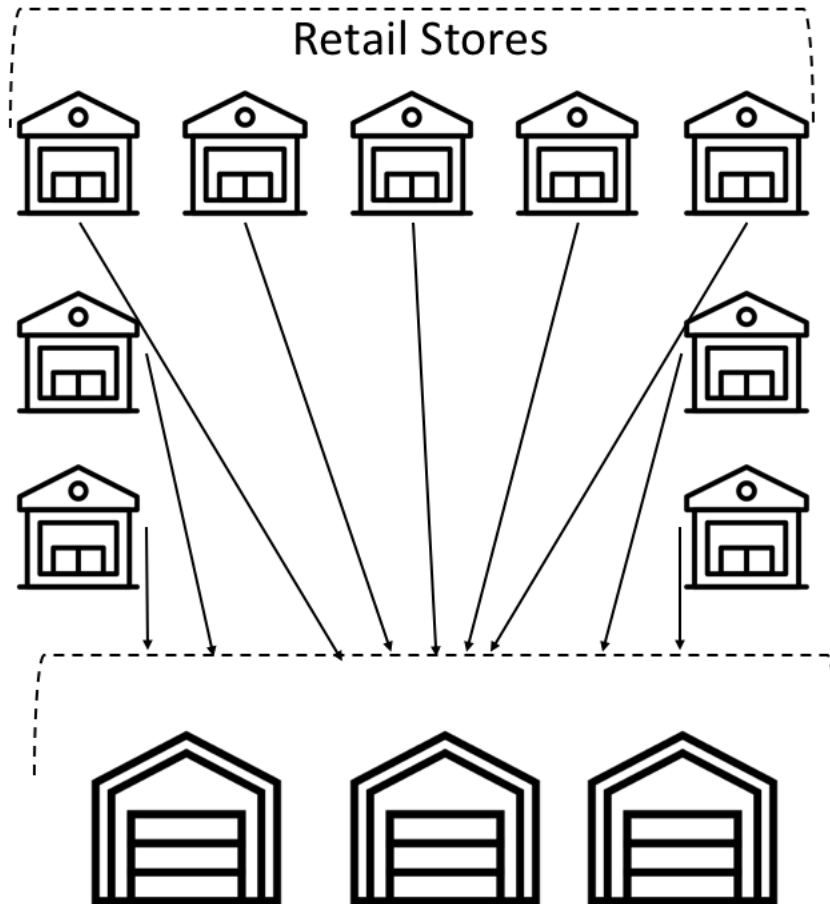
Figure 2: Decentralized Purchasing

Company Organizational Structure

Organizational structure refers to "the formal allocation of work roles and the administrations mechanisms to control and integrate work activities including those which cross formal organizational boundaries," as defined by Child (1972). Organizational structure is a topic that has been studied from a variety of lenses in a variety of settings. Corporations have long have wrestled with the issue of how to structure their organizations to enable employees to do their jobs with maximum efficiency and productivity (Walker & Lorsche, 1968). Regardless of the structure, Gill Corkindale explained in the Harvard Business Review how poor organizational design and structure results in employee confusion, lack of coordination, failure to share ideas, and slow decision making (2011).

The four most commonly recognized organizational structures in business are: functional-based, product-based (sometime referred to as divisional-based), matrix, and hybrid. Of these four, the two most common organizational structures are product-based and functional-based. A product organizational structure groups all of the functions around each different product, where the function organizational structure groups by the functions dealing with all of the products. Figure 3 displays the functional-based structure, and Figure 4 demonstrates a product-based structure.
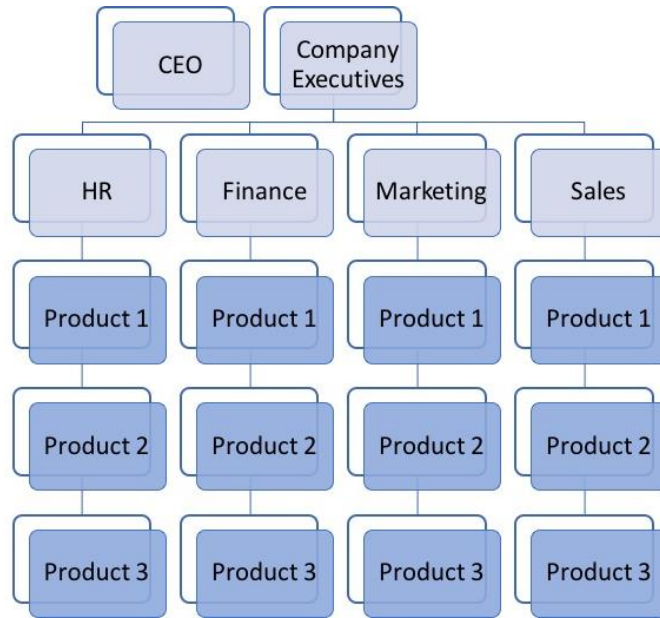
Figure 3: Functional Organizational Structure

Figure 4: Product Organizational Structure

A 1993 study on department store organization found that two thirds of the retail organizations used the five-function structure as the basis of their divisional organization (Lowry & Wahlers). Figure 5 displays a retail version of the five-function organizational structure. In this figure, the purchasing strategy is centralized, and purchasing is organized by product category.
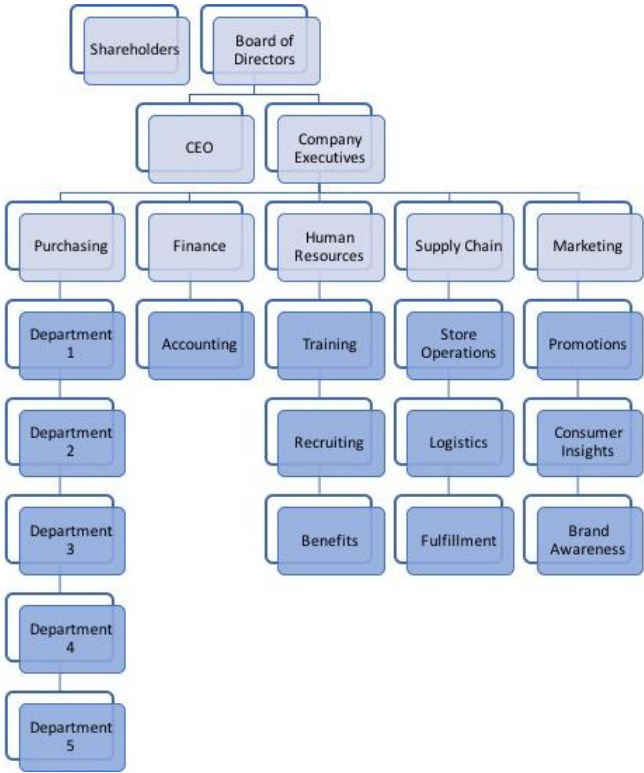
Figure 5: Retail Five-Function Organization Chart

Many studies looked at the financial success of a company as dependent on their organizational structure, however none of the studies has statistically significant conclusions. As is the answer in many business cases, it depends; though many studies developed advantages and disadvantages of each of the popular organizational structures.

Demand Planning

There is more data now available to companies on consumer behavior, preferences, and demographics as well as vendor trends than ever before. How to use this data to make profitable

business decisions is a dilemma many marketers and business analysts currently face. Demand planning is one area of business that uses data to make strategic decisions and plans for seasonal preference in the future. Suppliers find that the direct consumer demand for their products is much easier to predict than the demand from the retailers (Williams & Waller, 2010), which shows the inaccuracy of many demand planning techniques being used in retail. Predicting demand and managing inventory across multiple channels has been a major issue for retailers. Charles Chase (2017) noted that "companies will need to invest in new omni-channel demand planning and optimization technology that senses consumer demand across all channels" to successfully forecast consumer demand.

Purchase Order Creation

For retailers, the process of writing and placing orders is essential as it guarantees that products and services will be available for the consumer to purchase. The intent of a purchase order is to provide the vendor or supplier with the necessary information to deliver the products in the form, time, place, and at the right price. A purchase order is a legally binding contract between a buyer and a seller that details the exact services or merchandise to be provided by a vendor. Purchase orders will detail the delivery dates, payment terms, product quantity, shipping terms, and any additional information (Hudson, 2018).

There are many different purchase order formats used in the market and the specific format is dependent on the size and needs of each individual company. Though the format varies, there is certain information that is necessary for any supplier, buyer interaction. Table 1 outlines different purchase order elements that are needed for an order to be approved and fulfilled.

Table 1: Purchase Order Elements

Field	Description
Order Number	For retailers this is a purchase order number, for vendors this is the sales order number
Bill To	Customer Name and Address
Ship To	Location Name and Address
Vendor Information	Name, Number or Code
Date	Date purchase order is created
Merchandise Descriptions	SKU information (style, color, and size)
Merchandise Quantities	Normally go on the same line as the merchandise descriptions
Price	Specifies the unit price and total cost
Shipment Start Date	The earliest date the merchandise may be shipped from the vendor location
Cancel Date	The latest acceptable shipping or receiving date
Invoice Payment and Discount Terms	Any special deals or discounts you have negotiated
Shipping Instructions	If applicable
Packing Instructions	If applicable

Order Placement

Order placement is dependent on the type and size of the retail company. Though the act of writing orders has remained necessary to business, the way that orders are transmitted to the supplier has advanced with technology advancements. What used to be called 'mail-ordering', turned 'fax-ordering', turned 'computer-ordering' and has evolved into immediate response, electronic ordering. The most common form of purchase order placement is through Electronic Data Interchange (EDI). EDI is the computer-to-computer exchange of business documents in a standard electronic format between business partners (EDI Basics, 2017). EDI is almost universally accepted because of the ability to connect to ERP (Enterprise Resource Planning) systems. ERP systems are a shared database that supports multiple functions across different business units. ERP systems serve as the central nervous system for a business and they collect information from different functions and business units to make this information available to others, so it can be used productively.

Distribution Logistics

Retailers replenish their stores either through direct–to-store delivery from their vendors or through their own distribution centers (Williams & Waller, 2010). The fulfillment methods used by different distribution centers is dependent on the size of the facility, number of suppliers, and type of product to be distributed.

The rise of e-commerce has also led to more e-commerce distribution centers that operate with a lower quantity of high SKUs. The e-commerce distribution centers allow for shorter lead times without having to compete with wholesale orders for picking, packing, and shipping priority. In an omni-channel supply chain, some wholesale distribution centers treat the e-commerce distribution centers as an internal customer and ship product to be stored and slotted in the e-commerce facilities based on e-commerce sales and projections. The traditional retail distribution network is made up of stores, regional distribution centers, local distribution centers, and more recently, e-commerce facilities.

Crossdocking is a practice that allows for retailers to move cartons directly from inbound to outbound in their distribution centers by batching products by their final destination. Cross-

docking is a just-in-time strategy for distribution logistics. These cross-docked products are not stored as inventory in the retailer's distribution center.

Fulfillment Metrics

Key Performance Indicators (KPI) that are often used in order fulfillment are cycle time, on time shipping, order fulfillment accuracy, inventory turnover, average facility capacity, and cost, with many other metrics that are tracked daily. Costs can be either direct or indirect. Direct costs in fulfillment would include labor, material, and machine costs. Indirect costs are not directly related to the fulfillment of an order and would include overhead costs such as: administration, security, and office related costs, though there are others that can be measured depending on the facility. Direct costs are variable, meaning they change depending on time or on the quantity of orders being fulfilled.

Specific facility initiatives and projects often dictate what metrics are frequently measured and analyzed, but the key performance indicators remain consistent regardless of projects. KPIs often serve as a dashboard to understand the health of a distribution network.

Supply Chain Challenges

When looking at local supply chains, common challenges are customer service, cost control, planning and risk management, supplier-partner relationship management, and talent (Anderson, 2017). There are also a number of challenges associated with global supply chains such as fast changing markets, and meeting quality and compliance standards (Uhlenberg, 2017). It is often a balancing act for companies as they try to determine what their major supply chain challenges are and which challenges are worth tackling given their capabilities and constraints.

Companies must identify their core competencies and determine their strengths and weaknesses when evaluating their supply chain challenges. In recent years, companies have been working to make their supply chains a competitive advantage because of the value that is seen by the ability to provide their products and services in the correct form, time, and place. Building a strong supply chain that meets the needs of the business and the consumers is necessary for those businesses that wish to remain competitive and profitable.

Buyer-Supplier Relationships

The buyer-supplier relationship is a topic that has peaked business professional's interest over the past decade with emphasis being on vertical integration opportunities, transparency with upstream suppliers, communication, information sharing, and corporate social responsibility.

The Kraljic matrix maps supply items on the matrix based on supply risk and financial risk. The quadrant that the items fall into often dictates the interaction between buyer and supplier, or at least it historically has. The four quadrants are leverage items, strategic items, non-critical items, and bottleneck items (Webb, 2017). These relationships are often managed using supplier scorecards and having the buyer evaluate the supply periodically. This is common in retail as buyers often have to evaluate the value that the products bring to their business, and the supplier performance across different metrics. They are constantly looking for new suppliers and evaluating current relationships in order to provide the goods and services the consumers want.

Literature Review Discussion

Upon completing the literature review on topics related to purchasing strategy and structure and order fulfillment, discussions on the advantages and disadvantages of different methods and strategies were common, but conclusive findings from this research was rare. In the retail industry specifically, the success or failure of certain business practices are measured by looking at the success or failure of the retail company as a whole, and this is not always an accurate measure of success.

An important finding in this literature review is that many retail companies organize their centralized purchasing department by product category, whereas smaller retailers tend to use decentralized purchasing strategies. Also, the information on order management systems and purchase order creation was beneficial.

However, there is a literature gap that exists when looking at the impacts of retailer purchasing structure on vendor order fulfillment. The following chapters look to address this knowledge gap.

CHAPTER THREE
PROJECT DEVELOPMENT

Case Study Method

In order to evaluate the impacts of retailer purchasing structure on vendor order fulfillment, the researcher chose to use the case study research strategy. The steps of the case study method are: define the research question, determine data gathering and analysis techniques, collect data, evaluate and analyze the data, deliver the results and discuss the findings of the case study. This case study was done in cooperation with a company that operates an omni-channel supply chain in the retail industry.

Background Information

Company Background

The company is an apparel company that operates an omni-channel supply chain network. They supply their goods to customers through online sales, internal retail stores, and wholesale customers. This allows for a seamless and well-rounded consumer experience. Their product quality and brand loyalty has led the company to generate over $10 billion in yearly revenue for the past 15 years and they employ over 45,000 employees. They have over 1,000 internal retail stores and sell their product to over 1500 wholesale customers. Their distribution network in the United States is composed of 3 wholesale and retail distribution centers, 2 e-commerce distribution centers, and 1 storage facility.

Case Study Background

In one of the company's wholesale distribution centers, the operations team noticed a significant number of small boxes being used to pack and ship product to their wholesale retail customers. They received complaints from the wholesale customers about receiving truck loads full of small boxes. They also noticed facility disruptions due to the smaller boxes getting caught in the material handling equipment (MHE). This was a notable issue because their facilities were initially designed and built to pick, pack, and ship bulk size orders for their wholesaler customers. Through research, discussions, and meetings a list was developed of the causes of these small boxes.

There were certain situations in order management that would cause customer service to push partial orders to WMS to be picked, packed, and shipped. However, these situations were very rare contributor to the number of small of small boxes. It was also a possibility that the way the WMS dispatched work to the distribution center floor was causing small boxes. This was found to be insignificant, though this might be relevant for other companies.

This turned the focus upstream to look into how orders were being written and placed. The focus was on determining whether the small boxes were simply a result of orders being placed more frequently, or if other wholesale customer ordering methods were also contributing to these boxes.

Though it was found that wholesale customers were placing orders more frequently, it was also discovered that these more frequent, smaller orders were being placed by multiple different people within the same company.

It was discovered that large retailers using a centralized ordering strategy organize their buyers by product category. This led to the development of the research question and helped guide the topics of the literature review.

Research Question

Based on the company research and literature review, the research question is on determining the impact of centralized purchasing structure on vendor order fulfillment. The impact to be measured in this case study is financial impact, though the purchasing structure might have other measurable impacts on vendor order fulfillment as well.

In researching this question, it was hoped that the researcher would find conclusive results that could be used to make recommendations on order strategy and structure practices that would decrease order fulfillment costs.

Methodology

Once the research question was identified, the method used to answer this question needed to be established. A common tool used to imitate a real-world problem or process is simulation. Simulation modeling is the process of creating a digital model of a real-life process using mathematical models and interactions between agents to optimize certain parameters and/or make system improvements.

A comparison table was created and used to determine which simulation software could best answer the research question. This table is shown in the appendix and is labeled as Table 3.

AnyLogic was chosen due to the discrete event simulation capabilities, free student version, and ability to operate on different systems.

The animation and specific process modeling libraries were not weighted as heavily in this analysis because the research is focused on determining financial impact. AnyLogic allows the designer to create a model that mimics a real-world process by using relevant data to create parameters and agents that interact and flow like the business process.

Simulation Modeling Approach

AnyLogic supports the following modeling approaches: discrete event, system dynamics, agent based, dynamic systems, and multimethod modeling. The two methods that could be used to answer this research question were agent-based and discrete event simulation.

Agent-based modeling is a decentralized, individual-centric approach. The designer can identify the active agents and their behavior and put them in a certain environment that could potentially have connections established (AnyLogic, 2018).

Discrete event simulation model's certain situations and environments that appear to be "continuous." Discrete Event modeling is "process centric" where the system can be described as a process flow chart.

The researcher was looking to simulate an order being placed and fulfilled, and this resulted in choosing the discrete-event simulation. Agent-based simulation was also considered and briefly tested but was later dismissed because it was not as relevant to the research question as discrete-event simulation.

This research question is interested in following an order, a single agent, through the process of being sent and fulfilled using primary data. If the simulation was focused on the interaction of a customer, retailer, distribution center, and end user then agent-based simulation might have been selected.

CHAPTER FOUR

CASE STUDY: A SIMULATION APPLICATION

Data Collection

Once the research question and methodology were established, additional research and data collection took place to design the model. The first step in the data collection process was determining the current purchasing structures that wholesale customers operate under. This information was collected through meetings with the customer service departments and supply chain analysts. The researcher discovered that many major large retailers were structured by product category within their centralized purchasing department which supported the findings in the literature review. Many smaller retailers used either a decentralized ordering strategy or a combination of the two strategies. Nearly 60% of the retail companies that operated under the decentralized ordering structure had less than 300 total retail locations, which would make the decentralized strategy more attractive. This allows the retail locations to evaluate their inventory needs on an individual basis. There were also some smaller retail companies operating under the franchise business model which assigns the purchasing function to the individual store.

When looking the centralized purchasing structure, the researcher collected specific data on three companies that had centralized purchasing structures. The data was the basic company information, total number of ordering departments, total number of buyers, number of distribution centers, total number of stores, and ordering strategy. This data is summarized in Table 2.

These companies all had multiple buyers spread across the ordering departments. In this data the term 'ordering departments' means the same thing as the term 'product categories' which is previously mentioned in this report. These terms both refer to having different groups of buyers within the centralized purchasing unit.

Table 2: Retailer Information

Company	Total Ordering Departments	Total Buyers	Distribution Centers	Stores	Ordering Strategy
A	25	62	4	610	Centralized
B	22	44	10	1167	Centralized
C	18	72	8	1191	Centralized

Buyers within each department focus on their product categories and learn about consumer preferences, market trends, and popular vendors. Using this information, they create and submit contracts to vendors that guarantees certain amounts of product over a certain time period. Bulk orders are placed at the beginning of each season to fill in the stores with product. The number of seasons recognized per year varies by retailer. Throughout the season, buyers in each department place replenishment orders based on sales data and store inventory needs.

For company A, this means that 62 buyers spread across the 25 product categories are placing orders to their vendors for all of their stores. The frequency of replenishment orders placed depends on the size of the retailer, needs of their stores, and their forecasting accuracy.

For vendors that sell products that fall into more than one product category, they would be receiving orders from different buyers at the same company.

In researching the purchasing structure of retailers, it was important to understand order management in the ERP systems. This company's ERP system does not allow for sales orders to be combined or consolidated in any way. Also, if an order has product with different shipping locations, the products will be put into different boxes. The shipping number is used to tell the vendor where the products are going, which is commonly the distribution center of the wholesale customer. Many orders also have a final store location tells the wholesale customer where the final destination of the box is. This allows for the retail customer to cross-dock the boxes to the final store location. Cross-docking is the process of moving product from the inbound area to the outbound area without having to store the product or carton as inventory in the distribution center, as defined in the literature review.

Figure 6 illustrates this centralized ordering model flow by showing different purchasing departments placing orders that are packed into multiple cartons, then cross docked for their final store destination.

Once the centralized ordering structure was fully understood and mapped, the researcher worked to get raw order data. The data collected and analyzed looked at 3 months of order data. This data had information on the Customer Number, Order Number, Pack Date, Ship Date, Box Number, Material Number, Quantity of Product, Shipping Number, and Store Number. This data began on January 1 and ended on March 1. These three months gave an in-depth snapshot of order placement behavior. Retailers recognize anywhere from 10-20 consumer seasons (Nassauer, 2011) and looking at these three months would account for seasonal fluctuations. The researcher decomposed the data using Tableau and Excel by looking at different order elements in combination with each other. This information, with over 600,000 rows of data, showed that larger major retailers were placing orders more frequently and in smaller quantities, than smaller, specialty retailers that placed significantly fewer orders. This data and subsequent analysis allowed the researcher to design the simulation based on accurate order data, and thoroughly answer the research question.

Modeling Characteristics

The discrete event simulation was designed to imitate an order flowing through a vendor's inventory and customer service checks before being sent to the distribution centers to be picked, packed, and shipped to the retailers stores or distribution centers. Figure 7 shows this process in a process map. Figure 9 in the appendix shows the unanimated AnyLogic Model.
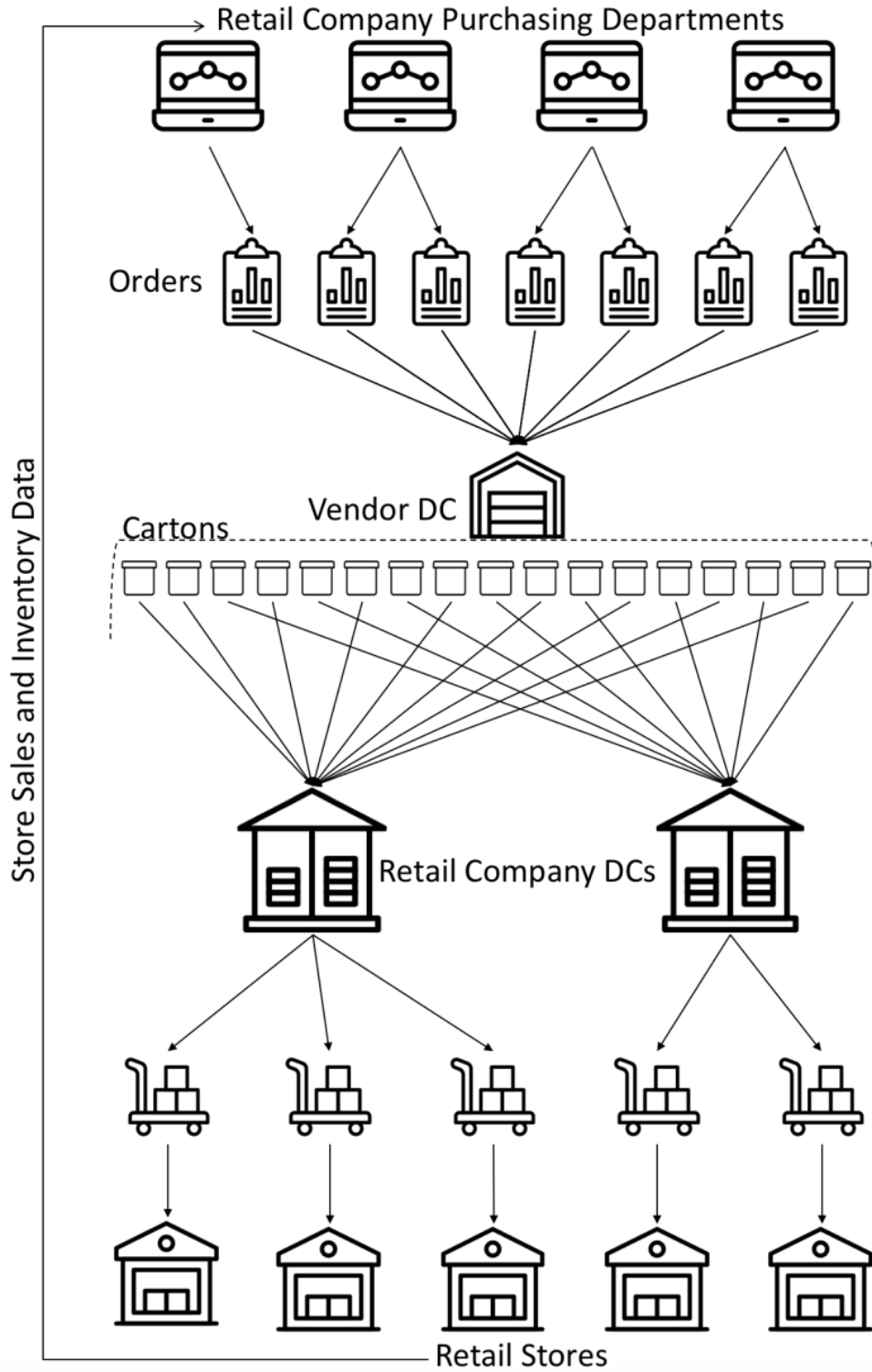
Figure 6: Centralized Ordering Structure
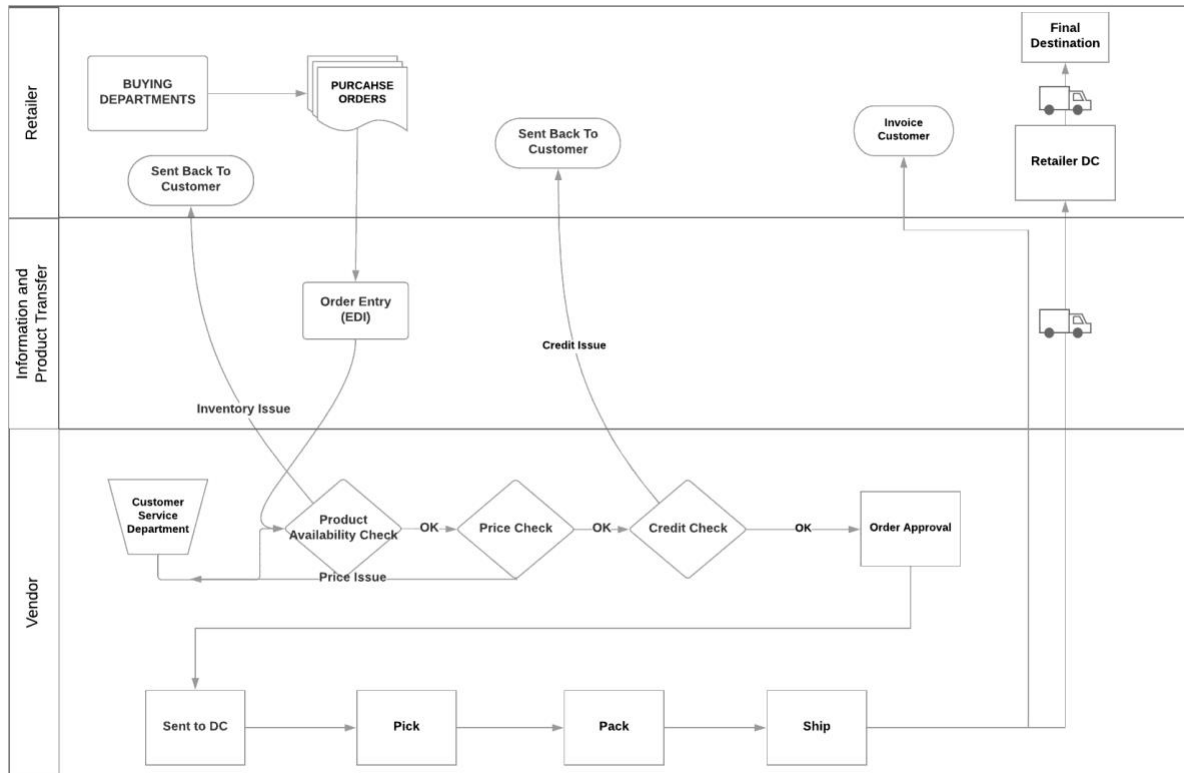
Figure 7: Order Process

Translating the order data into a simulation model proved to be a difficult task when considering the different factors that contribute to order fulfillment. The researcher pulled data for one customer (Company A in Table 2) by using the customer number. Using this customer, the order information was used to create parameters and variables in the simulation.

Model Assumptions and Parameters

By looking at one customer, there was more visibility into the products that were being ordered and the quantities of each product. The average number of orders placed per week by this customer was 285.45. There are 25 ordering departments, but the product from the vendor only falls into 10 of these different categories. This information was used to calculate the arrival rates of the orders:

$$\frac{Average\ Weekly\ Orders}{Ordering\ Departments} = \frac{285}{10} = 28.5\ orders\ per\ week\ per\ ordering\ department$$

The main agent was an order. Upon each arrival, the order was linked to four parameters: Product Quantity, Order Date, Number of Shipping Locations, and Department. The parameter values came from distributions calculated from the order data. These are as follows:

$$Product\ Quantity: lognormal(6, 100, 1)$$

$$Order\ Date: Date$$

$$Shipping\ Locations: triangular\ (1, 150, 5)$$

$$Department\ Name$$

The costs of the four box types were calculated by dividing the company box sizes into four equal categories: Extra Large, Large, Medium, and Small. The cost of each category was found by averaging the cost of all of the boxes included in each category (Table 6), with the resulting costs shown below:

$$Cost_{SmallBox} = \$0.39$$

$$Cost_{MediumBox} = \$0.46$$

$$Cost_{LargeBox} = \$0.60$$

$$Cost_{XLargeBox} = \$0.68$$

The labor cost was calculated using the average hourly pay rate for employees.

$$CostPerHour_{Labor} = \$14.25$$

Model Logic

There were 10 sources for agents, designed to imitate the 10 ordering departments. When orders arrived at the source they were evaluated based on their order quantity. Orders with quantities between 100 and 200 were considered bulk orders and were sent to be picked, packed, and shipped using extra-large boxes.

All of the other orders went through a series of checks to confirm that the order information was correct. The number of checks an order goes through is dependent upon different order parameters. There are three checks that remain consistent for every order and they are the product availability check, the customer credit check, and the price check.

The approval rates were probabilities that came from customer service data and are shown below:

$$Approval\ Rate\ for\ Product\ Availability\ Check = .94$$
$$Approval\ Rate\ for\ Order\ Credit\ Check = .98$$
$$Approval\ Rate\ for\ Price\ Check = .99$$

The orders that did not pass these checks were considered failed and the agent was terminated. The other orders continued through the process. From here the orders were transmitted to the distribution center.

Here the quantity of the order was evaluated again, and orders were split into three different process lines based on their order quantities.

- Orders with Quantities between 50 and 100 were shipped in Large Boxes. Upon entering this process, the number of Large Box Orders increased by 1.
- Orders with Quantities between 12 and 50 were shipped in Medium Boxes. Upon entering this process, the number of Medium Box Orders increased by 1.
- Orders with Quantities between 0 and 12 were shipped in Small Boxes. Upon entering this process, the number of Small Box Orders increased by 1.

The number of actual boxes used was calculated using a version of the following equation. This version was adjusted for each different box size calculation:

$$Total\ [Small\ Boxes] = ([Small]\ Box\ Orders) * (Number\ of\ Shipping\ Locations)$$

This calculation was developed because product on an order with different shipping locations must be packaged in different boxes. Orders are destination based so the number of shipping locations will automatically split an order into small boxes. So, the number of boxes needed is dependent on the number of shipping locations on each order.

The financial impact was calculated using the equation below:

$$
\begin{aligned}
Total\ &Direct\ Cost \\
&= ((Number\ of\ Large\ Boxes) * (Price_{LargeBox})) \\
&+ ((Number\ of\ XLarge\ Boxes) * (Price_{XLargeBox})) \\
&+ ((Number\ of Medium\ Boxes) * (Price_{MediumBox})) \\
&+ ((Number\ of\ Small\ Boxes) * (Price_{SmallBoxes})) \\
&+ ((Labor\ Cost\ per\ hour) * (LaborHoursPerBox) * (Number\ of\ Boxes))
\end{aligned}
$$

Case Study Results

To determine the financial impact, the simulation was run using two different designs.

- The first design has 10 different sources or "order departments". The exact parameters in this model are described in the previous section. The total cost after running the model for 3 months was:

$Total\ Direct\ Cost$

$$= ((1020) * (.6)) + ((1980) * (.68)) + ((2000) * (.46)) + ((35880) * (.39)) + (($14.25) * (408.8)$$
$$= \$22{,}697$$

- For the second design, the researcher consolidated the orders by date into as few orders as possible, and then found the new product quantity parameters with a minimum of 1, maximum of 100 and average quantity of 39. Rather than having up to 10 departments placing orders, there was only one ordering source. Using the original model logic, only one source was used, while the other 9 sources were dormant. The rest of the simulation logic remained the same. Figure 8 shows this adjusted ordering structure. This consolidation led to higher quantity of product on each order which led to larger boxes being used even when there were multiple shipping locations on an order.
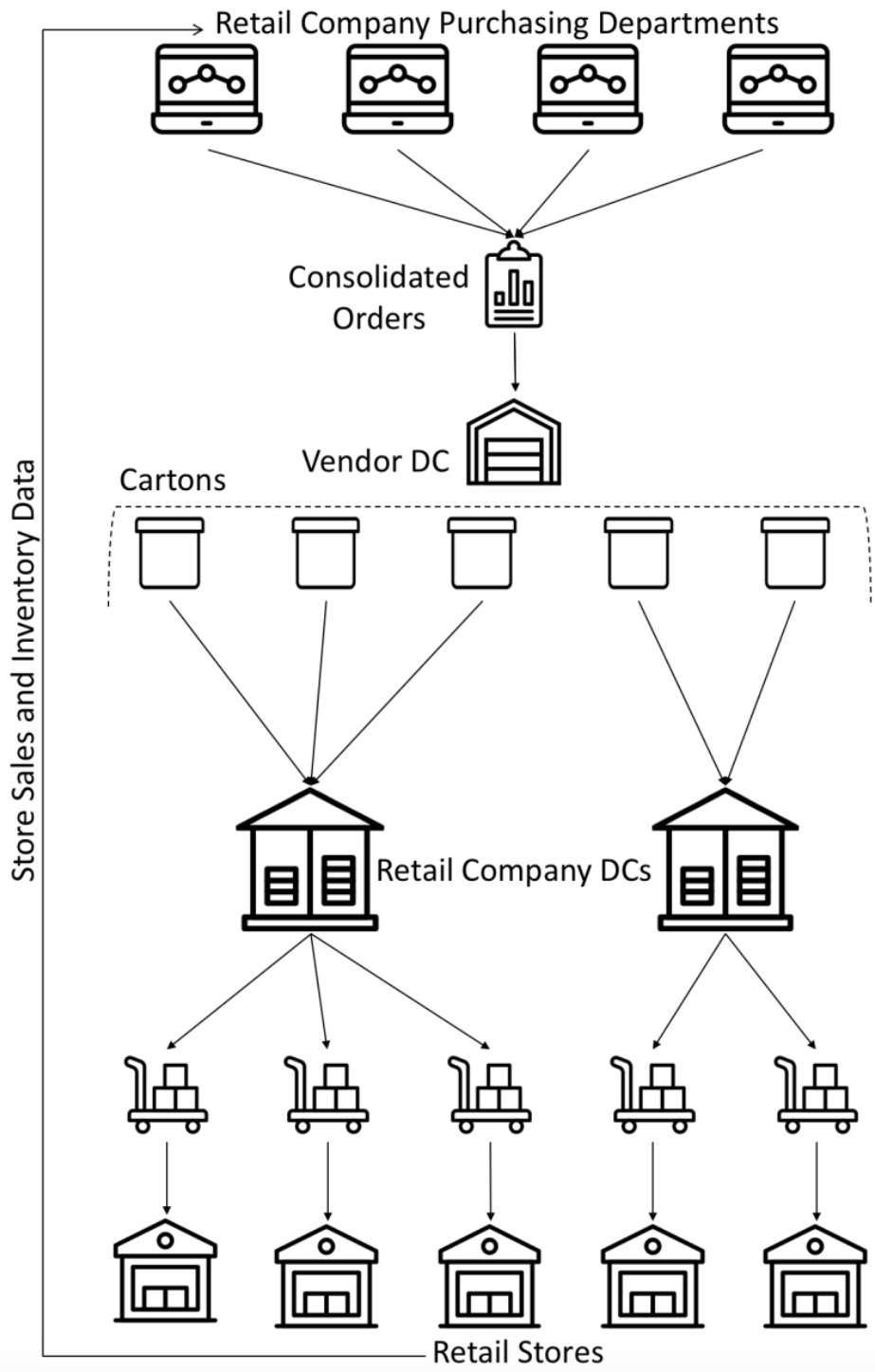
Figure 8: Adjusted Ordering Structure

$$Total\ Direct\ Cost$$
$$= ((14790) * (.6)) + ((1650) * (.68)) + ((3650) * (.46)) + ((9860)$$
$$* (.39)) + (($14.25) * (250.2)$$
$$= $19,085$$

This new total cost is an almost 16% decrease in total direct fulfillment cost. Both of the model designs were run multiple times and the results are summarized in Table 3. These different models are for one specific retail customer. When these costs are calculated annually for the top 50 customers, the financial impact is more apparent. The total costs were adjusted based on volumes for the top 50 customers, and these total costs were added together. The overall financial impact is summarized in Table 4.

Table 3: Total Cost Results

Run	Design 1	Design 2
1	$22,697	$19,085
2	$23, 532	$19,366
3	$22,964	$18,374
4	$21,320	$18,064

Table 4: Overall Financial Impact

	Design 1	Design 2
Total cost for 50 customers over a 3-month period	$1,134,170	$958,698
Total cost for 50 customers over 12-month period	$4,536,676	$3,834,795

Discussion

The assumption behind these cost savings is that it is less expensive to put a lot of product into one big box than it is to put the same product into a lot of smaller boxes. Also, it takes more labor to pick, pack, and ship multiple small boxes than it does to pick, pack, and ship a single large box. This is due to the extra processing time and time it takes to close and move the boxes.

There are many other impacts that were not directly studied in this case study but would provide a more complete picture of wholesale customer fulfillment if expanded upon in future research.

The findings of the impacts of the centralized purchasing structure on vendor order fulfillment is as follows:

- o Placing orders by product category is more expensive for vendor order fulfillment when the vendor is selling product that that falls into more than one product category.
- o This results in the vendor receiving multiple orders from multiple buyers from the same retail company, which can exponentially multiply the number of small boxes needed to fulfill these orders, especially for a larger vendor.

One disadvantage of this simulation approach is that in the second model, it assumed that much of the other order information directly lined up with orders that had the same order date, however it is likely that each order has different and unique information in other order fields that would cause the order to be packed into smaller boxes.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

Based on the results, there is potential for a 16% decrease in direct fulfillment costs when retail companies consolidate their orders before sending through EDI. This decrease in costs was calculated by looking at cost of labor and cost of corrugate. There are countless other fulfillment costs and relevant metrics that can and should be considered as well when looking at overall fulfillment costs.

Order Consolidation

By consolidating orders, retailers would most likely see larger boxes being cross-docked to each of their stores rather than a lot of small boxes being cross docked to their final location. From an order management perspective, generating multiple orders per week makes sense from a rapid replenishment standpoint, but this also creates more orders to keep up with and monitor, thus making order management more tedious. Some fundamental questions that needs to be answered by retail companies with centralized purchasing strategy are: What is best for their store operations? Do they prefer opening and unpacking a high number of smaller clearly labeled boxes from the same vendor, or one large box with all the product for all of their departments that they then need to distribute throughout their stores? ***If retail companies do not have a strong preference, then consolidating orders by date is recommended.***

Structure Evaluation

As the fundamentals of retail are changing, it is necessary for retailers to change and evaluate business processes as well. Beyond just order consolidation, there is the option to ***restructure centralized purchasing all together***, though this might be an extreme recommendation.

Currently in centralized buying structures, buyers are focusing on specific product categories rather than on the consumer, though they do conduct consumer research. This hyper focus on product categories focuses efforts on pushing the best products to the consumers rather than looking to the consumers to listen to what they want to buy. Some fundamental changes within centralized purchasing might allow for all of the buyers to work together to fully understand the

consumer, especially their preference across other channels, and not just in brick-and-mortar stores. Product expertise has been beneficial for retailers in the past, but the retail environment has shifted the focus to be on the consumer rather than the products they provide, with some retailers claiming to be 'consumer obsessed.'

Additional Notes

It is important to note that this case study was conducted on a retail company that offers product that falls in different product categories. These findings would not be the same if the study was completed with a vendor that provides specialty product that is only found in one product category. However, many companies take advantage of economies of scope which decreases the per unit cost by producing two or more different products. Many vendors, especially in the retail industry see their product fall into more than one product category.

Conclusions and Project Expansion

In an unpredictable and changing retail environment it is hard to say what will make a retail company successful in the coming years but there are some predictions. The researcher believes that consumer focused, and data driven retail companies will thrive, while others will struggle to remain profitable especially in the brick-and-mortar channel. Also, retail companies that fully integrate their e-commerce operation into their business model will probably be more successful than those retail companies that do not fully integrate this business function.

Companies and businesses should consider all cost-savings found in their supply chain as a way to pass savings onto their consumers. Customer retention is a key metric used to measure success, and retailers must win over consumers with every interaction in order to retain these consumers (Masthanvali & Babu, 2017), and lower unit price might be a way to do this. With potential cost-saving opportunities this research question is one that can be expanded upon by individual businesses if they evaluate their supplier network and purchasing structure. For industry research there is plenty of room to grow and expand upon this research to get a better understanding of how retail companies do business with each other. Best practices in ordering structure could also eventually be developed using this research as a basis.

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APPENDIX

Table 5: Simulation Software Comparison

	Operating System	Industries of Application	Free Version?	Compatible Software	Simulation Methodologies
Arena	Windows	Manufacturing, Supply Chain, Government, Healthcare, Logistics, Food and Beverage, Mining, Call Centers		OptQuest	Discrete Event
AnyLogic	Windows, Mac, Linux	Manufacturing, Supply Chains and Logistics, Warehousing, Business Processes, Healthcare, Pedestrian Dynamics, Railroads, Vehicle Traffic, Oil and Gas, Mining, Defense, Social Processes, and more	✔	Excel, Access, Database, OptQuest	Discrete Event, Agent Based, System Dynamics
Enterprise Dynamics	Windows, Mac	Manufacturing, Material Handling, Logistics	✔	Various	Discrete Event
ExtendSim	Windows, Mac	Manufacturing, Business, Healthcare, Security and Defense, Transportation, Pharma, Environmental Engineering, Communication		Excel, Access, SQL, JMP, Minitab, MySQL	Discrete Event
FlexSim	Windows	Manufacturing, Packaging, Warehousing, Material Handling, Supply Chains and Logistics, Healthcare, Factory, Aerospace, Mining	✔	Excel, Database software, C++ Applications	Discrete Event
Simio	Windows	Academic, Aerospace and Defense, Healthcare, Manufacturing, Military, Oil and Gas, Supply Chains, Transportation		Azure, Access, Excel, MySQL, Wonderware, OptQuest	Discrete Event
Simul8	Windows	Manufacturing, Healthcare, Education, Engineering, Supply Chains, Business, Lean, Public Sector, Call Centers		Excel, SQL Databases, OptQuest	Discrete Event

Figure 9: AnyLogic Model Logic

Table 6: Box Cost Data

Carton Type	Price	X Large	Large	Medium	Small
1	$0.23				$0.35
5	$0.34				$0.36
6	$0.35				$0.38
7	$0.35				$0.39
8	$0.36				$0.41
10	$0.40				$0.42
12	$0.43			$0.42	
13	$0.46			$0.43	
14	$0.48			$0.44	
15	$0.52			$0.45	
16	$0.58			$0.47	
17	$0.59			$0.52	
19	$0.64			$0.50	
21	$0.66		$0.52		
22	$0.67		$0.58		
23	$0.67		$0.59		
24	$0.69		$0.60		
25	$0.72		$0.62		
27	$0.75		$0.63		
28	$0.77		$0.63		
32	$0.91	$0.64			
33	$0.92	$0.65			
34	$0.95	$0.66			
36	$1.02	$0.70			
37	$1.04	$0.76			
		0.68	0.60	0.46	0.39

VITA

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