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A Case Study of the Navy Exchange Service Command West Coast Distribution Center's Planning Approach to Automation and Robotics

December 2024

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Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
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NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

This study investigates the planning process for implementing automation and robotics in the warehouse operations of the Navy Exchange Service Command (NEXCOM), a military retailer, within the Department of Defense. The study explores the current situation of warehouse operations, distribution center, and distribution processes at NEXCOM and why the retailer is motivated to shift and improve processes with advanced technologies. The research examines specifics to the unique challenges and considerations when integrating automation and robotics faced by a government-owned entity, focusing on the decision-making process within the military retail context. A qualitative analysis and a case study of NEXCOM's West Coast Distribution Center in Chino, CA, provides insights into these complexities. Additionally, the research explores other alternatives to improve processes without the use of automation and robotics to aid in the decision-making process and evaluation of integrating and implementing automation and robotics.

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LIST OF ACRONYMS AND ABBREVIATIONS

3PL	third-party logistics
AAFES	Army & Air Force Exchange Service
AS/RS	automated storage and retrieval system
ASN	advance shipping notice
BBA	business-based action
C.F.R.	Code of Federal Regulations
CEO	chief executive officer
COA	course of action
COVID-19	coronavirus disease 2019
CPI	continuous process improvement
CT	craft and trade
CY	child and youth
DC	distribution center
DoD	Department of Defense
DoDI	Department of Defense Instruction
G2P	goods to person
ISO	International Organization for Standardization
IT	information technology
MWR	Morale, Welfare, and Recreation
NAF	non-appropriated fund
NAFI	non-appropriated fund instrumentality
NAVFAC	Naval Facilities Engineering Command
NAVSUP	Naval Supply Systems Command
NEX	Navy Exchange
NEXCOM	Navy Exchange Service Command
NF	non-appropriated fund white-collar
OPM	office of personnel management
ROI	return on investment
U.S.C.	United States Code
WCDC	West Coast Distribution Center

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I. INTRODUCTION

This chapter provides the purpose of the study, explanation of the problem description, limitations, and research questions of the study.

A. PURPOSE

The purpose of this study is to investigate the planning process and its factors for implementing automation and robotics in warehouse operations of the Navy Exchange Service Command (NEXCOM). Naval Supply Systems Command (NAVSUP) and NEXCOM have stressed a high priority of integrating robotics into its warehouses, to include distribution centers (DCs) (Epps, 2024; Navy Exchange Service Command [NEXCOM] 2024). This research focuses on how and why NEXCOM is shifting its priority toward new technology in its warehouse operations and DCs while staying current with the advancements of the private sector in retail.

The adoption and implementation of automation and robotics is not new to warehousing. Automation and robotics are on a steady incline over the last decades and companies are investing more capital funds towards these projects (Berkers et al., 2023; Ajewole et al., 2023). The body of knowledge for reasons and motives for why companies are advancing their capabilities in warehouse operations and DCs is limited in scope. Most of the body of knowledge focuses on the automated equipment and robotic modules in warehousing (Vijayakumar & Sgarbossa, 2021). The body of knowledge is minimal, specifically addressing the motivations and challenges behind the shift towards automation and robotics in the retail industry, especially in military retail. Although NEXCOM may share many of the same operational goals with the private sector, its government ownership and distinct operational context makes for a nuanced understanding of its approach to the planning process for automation and robotics in the warehouse.

This research uses a case study approach with qualitative analysis to focus on the NEXCOM's plan to integrate automation and robotics to its West Coast Distribution Center (WCDC) in Chino, CA. The case study seeks to understand the leadership and management's views and perspective on the planning process to provide valuable insights

into the complexities of planning and implementing advanced technologies in the military retail environment.

This qualitative study aims to fill the research gap by examining the motivations, concerns, and challenges behind the planning process and exploring other considerations to advance warehouse operations without automated solutions. Understanding why military retail organizations choose to automate their warehouses may provide further insight to understanding the complexity of the process. Our intention is not to generalize the research to other organizations, but rather provide a framework when choosing to begin the planning process for implementing automation and robotics into the Chino warehouse operations.

B. PROBLEM DESCRIPTION

Inside the warehouse, there are extensive manual processes with manual labor and material handling systems as the warehouse's primary processing component. Warehouses are both a simple and complex concept that can be a rigid part of the supply chain. As noted by Baker and Halim (2007), the warehouse equipment can become outdated and lead to inflexibility of the warehouse operations. Rapid advancements in technology have changed the landscape of warehouse operations and can drive change as an innovative disruptor to the supply chain. More companies are likely to receive robotics and warehouse automation shipments, and warehouse automation is expected to grow annually by 10% each year by 2030 (Davies et al., 2023).

Automation offers an innovative solution to the challenges of warehouse operations. As the capabilities of automation and robotics become more advanced, companies are working towards integrating these technologies with their workforce. Companies with warehouses and extensive distribution networks, such as Amazon, Walmart, and Kroger, are abandoning manual tasks in favor of automation to streamline processes and improve warehouse throughput (Hu et al., 2023).

Companies are motivated to advance their capabilities to be competitive. There are several motivations as to why a company chooses to implement robotics. Companies seek to implement robotics for a variety of reasons, to include addressing the challenges of labor

and workforce, accommodate growth, cost reduction or efficiency, improve process efficiencies, maximize warehouse space utilization, and improve fulfillment times, and customer service reliability (Davies et al., 2023). The motivation for the introduction of robotics can produce potential benefits, however, success and a good return on investment (ROI) require a large financial investment to upgrade. An article from the Boston Consulting Group noted that companies previously considered automation as cost-prohibitive and expensive to justify the potential benefits, however, the dynamic is shifting (Hu et al., 2023). The article highlighted the large financial investment is now a viable option with a shift in dynamics through focused planning, labor shortages, and complexities in the supply chain (2023). The process of integrating robotics is intricate with many different internal and external factors during the implementation phases that involve high level deliberate planning and cohesion to be successful.

NEXCOM is approaching the time to advance their warehouses by integrating more robotics and automation. In this regard, the government-owned retailer is unique from the private sector because it lacks an independent streamlined process. In addition to a bureaucratic organizational structure and a workforce of non-appropriated fund (NAF) employees, NEXCOM needs to consider further policy and regulatory considerations to analyze and align with other Department of Defense (DoD) agencies and Congress.

NEXCOM prioritizes its goals beyond maximizing profits and growing its market share because the patrons have a unique need. The motivation of the military retailer focuses its sales on lower prices in a few concentrated military areas rather than the widespread presence and competitive nature of the private sector. NEXCOM does not stress displacing big box retailers with their sales or market share, rather NEXCOM is there to serve their market share and accommodate their diverse needs. (NEXCOM Manager, email to authors, September 24, 2024; NEXCOM, n.d.). Instead of seeking to expand its customer base and its inability to expand into a new market share, NEXCOM focuses on serving its existing customers. The military retailer recognizes the limitations and constraints of the current state of military recruitment and retention in 2024. Unlike the private sector that can gain new customers, NEXCOM cannot easily increase its customer base due to stagnant personnel numbers in the military and exclusive sales to DoD

personnel. Coupled with stagnant market growth, NEXCOM profits have remained steady since rebounding from the coronavirus disease 2019 (COVID-19) pandemic between 2022–2023 (NEXCOM, Annual Reports 2018; 2019; 2020; 2021; 2022; 2023). NEXCOM is not profit-maximization driven in the same fashion as the private sector as their profits return to bettering the military community, so the reasons to integrate automation and robotics at their warehouses are unique because there is no need to keep ahead and gain a competitive advantage against private retailers.

This case study of NEXCOM at their WCDC in Chino highlights a unique scenario where a government organization, despite not profit-motivated by competition and serving a unique customer base, seeks to implement automation at their warehouse. Another layer to add to this case study is a potential decision to relocate the Chino warehouse to a new facility within 50 miles or remain at the current leased warehouse. The potential decision of which path to choose can further complicate the planning process. This movement towards automation and robotics is deemed a strategic decision, but with a government entity, the approach requires a cost-effective plan and minimal disruption during integration while maximizing the ROI.

DoD organizations tend to be more bureaucratic with their processes with projects of this scope, which can prolong and complicate the process of implementation of the automation. While they recognize the benefits of adopting approaches like the private sector, they must also adhere to specific regulations and navigate bureaucratic hurdles. This research attempts to address the complexity and underlying reasons behind the decision to integrate, by addressing the challenges of how a government entity in retail advances toward new automation and robotics, the motivations to integrate that may arise in successful or failed implementation. Additionally, provide recommendations regarding inefficiencies that could benefit warehouse operations to improve without automation.

C. LIMITATIONS

The focus of the research is constrained to the factors in the decision-making process for implementing automation and robotics. The case study and qualitative analysis focuses on a snapshot of time at one warehouse of the NEXCOM distribution network. The

examination and results gathered limit the generalizations to outside organizations because the viewpoint is applicable to only this warehouse. While it is not our intent to generalize the information to outside the DoD and other organizations, the research hopes to contribute to the body of knowledge on what considerations can be gleaned from this analysis in other decision-making processes.

The research does not aim to evaluate the specific automation companies considered by NEXCOM. Instead, it focuses solely on analyzing the planning approach that NEXCOM deems optimal for implementing these technologies within their WCDC. The researchers examined several automation and robotics companies to understand the types of capabilities the companies offer.

The researchers use interviews as a primary qualitative data collection method. The researchers interviewed NEXCOM operations and logistics management, and the WCDC General Manager based on time and availability of their staff. The research team understands the sample size was limited. The interviews did not engage stakeholders in the decision-making process outside of the operations department. During the interviews there were other stakeholders and DoD organizations identified and involved in the planning process. The topic is so encompassing that time and availability were the constraints in the interviewing other stakeholders. Other identified stakeholders involved in the decision-making process can include NEXCOM Chief Executive Officer (CEO), NEXCOM employees and unions, NEXCOM purchasing and merchandising, Naval Facilities Engineering Command (NAVFAC), other applicable commands, and DoD leadership, and Congress.

D. RESEARCH QUESTIONS

For this case study, we address the following research questions:

1. What is the motivation for a military retail store, specifically NEXCOM, to make incremental changes to manual processes by implementing automation and robotics in their distribution center?

2. What are the concerns and challenges for the NEXCOM West Coast Distribution Center in the planning approach to implementing automation and robotics?

3. Beyond robotics and automation, what strategies can NEXCOM implement to improve operations?

In summary, we provided the purpose of the study, explanation of the problem description, limitations, and research questions of the study. The next chapter is the literature review focusing on the aspects of NEXCOM warehouse and DC operations, motivations, concerns, and challenges applicable to implementing automation, and other warehousing concepts.

II. BACKGROUND AND LITERATURE REVIEW

This chapter reviews federal NAF employee policies, the status of NEXCOM's DC network, and operational concerns and considerations for the WCDC with regards to automation. Next, we examine studies by Baker and Halim (2007) and Berkers et al. (2023), which established motivations behind automation projects. The Varghese and Saju (2021) thesis provided an in-depth case study that develops concerns and challenges behind automation projects at a single warehouse. We conclude the chapter with an introduction to select warehouse concepts.

Warehouse automation is a high priority for the NAVSUP enterprise (Epps, 2024). This extends to NEXCOM, which is supporting NAVSUP's vision by prioritizing automation and optimization in their DC network (NEXCOM, 2024). Implementing automation is a significant investment and is not without challenges. Once the decision has been made to automate, the next steps are the planning and implementation phases, which is the focus of this research. This chapter presents the key elements of NEXCOM's basic manpower composition, current warehouse scope and practices, current technologies in use, and technologies that are being considered, primarily automation. This chapter also analyzes multiple books, journal articles, and case studies that show where private industry stands with warehouse automation and challenges encountered when implementing automation in warehouses. These topics illuminate the areas where NEXCOM lags private sector counterparts and provide challenges learned in the private sector that can apply to organizations that desire to automate warehouses.

A. DEFINING AUTOMATION AND ROBOTICS

Automation is a broad category due to the wide range of other technologies associated with the category. To understand the scope of the category, the research uses the following to define the differences between automation and robotics.

Through the research on scholarly literature, our definition of automation is the implementation of novel machinery and intelligent control systems with functions to supplant human involvement in execution of manual tasks. In *Warehouse Science and*

Distribution, "automation is the substitution of mechanical for human labor" (Bartholdi & Hackman, 2017, p. 193).

Automation includes robotics and the terms are used interchangeably, however, robotics is a field of study. For this research, we focus on the definition from the International Organization for Standardization's (ISO). In the terms and definition section of the ISO 8373:2021 section 3.3, robotics technology defines the term robotics, which is the "practical application knowledge commonly used in the design of robots or their control systems, especially to raise their degree of autonomy" (International Organization for Standardization [ISO], 2021). Coupled with this definition from the terms and definition section of the ISO 8373:2021 section 2.6, the ISO definition of robots, "programmed actuated mechanism with a degree of autonomy to perform locomotion, manipulation or positioning" (2021). We derive our own definition for robotics with respect to warehousing and distribution processes as the characterization of the design and application of intelligent machines to augment human execution of manual tasks involving physical interaction with the environment. The research utilizes the definitions from ISO and our derived definition to establish and analyze warehouse operations, distribution processes, and retail warehousing.

B. NAVY EXCHANGE SERVICE COMMAND

This section provides a brief overview of the NEXCOM scope and mission. It discusses the NEX and how it operates within the NEXCOM enterprise.

1. Scope and Mission

Under the NEXCOM is the Navy Exchange (NEX), a retail store and service chain whose mission is to provide goods and services at a savings for authorized customers, to include active-duty military, retirees, reservists, their families, and NEXCOM employees. As the retail store under the NEXCOM enterprise, the NEX has a unique position with an exclusive customer base focused around Navy fleet concentrations areas worldwide. The NEX operates like many other major retail big box stores and strip malls, selling a wide range of goods and services–consumer products, barbershops, laundry, and other services. There are unique characteristics of the NEX that differentiate it from others in the retail

industry. The military retail store has a distinctive customer base, tax free shopping, military uniform items, and profits are reinvested back into NEXCOM enterprises and Morale, Welfare, and Recreation (MWR) programs.

The NEX resembles a retail store, however, its operation is distinct from the private sector in the areas of price and worldwide coverage. Adding to further distinction from the private sector, the NEX has a position within government and a reliance on a federal workforce. With the connection to the federal government, NEXCOM's growth is intrinsically linked to the number of Naval installations and personnel worldwide. Congressional funding and recruitment efforts impact the retail operator's expansion and internal operations. This unique position makes it difficult to compare NEXCOM directly to the private sector in terms of competition and certainly one that means displace competitors.

The NAF monies cover operating costs, employee salaries, and emergency reserves with the remaining profit returning to benefit and improve the quality of life for the military community. The NEX is a standalone operator in the Naval concentration areas, but not the only other military retailer as the Army & Air Force Exchange Service (AAFES) services the other part of the military community. While the NEX caters primarily to Navy personnel, both stores allow access to all DoD personnel, and these are the most prominent two stores in the military community.

2. Workforce and Distribution Center Operations

This section provides a brief overview of the federal composition of NEXCOM manpower, specifically the employment of primarily NAF employees, status of DC operations, and concerns and considerations for the WCDC.

a. Non-Appropriated Funds Employee Policy

A unique aspect of NEXCOM operations when compared to the private sector counterparts is the status of employees as NAF employees. 5 U.S. Code (U.S.C.) 2105(c) defines NAF employees as:

(c)An employee paid from nonappropriated [sic] funds of the Army and Air Force Exchange Service, Navy Ships Stores Program, Navy exchanges, Marine Corps exchanges, Coast Guard exchanges, and other instrumentalities of the United States under the jurisdiction of the armed forces conducted for the comfort, pleasure, contentment, and mental and physical improvement of personnel of the armed forces is deemed not an employee for the purpose of—

(1) laws administered by the Office of Personnel Management, except—

(A) section 7204;

(B) as otherwise specifically provided in this title;

(C) the Fair Labor Standards Act of 1938;

(D) for the purpose of entering into an interchange agreement to provide for the noncompetitive movement of employees between such instrumentalities and the competitive service; or

(E) subchapter V of chapter 63, which shall be applied so as to construe references to benefit programs to refer to applicable programs for employees paid from nonappropriated [sic] funds; or

(2) subchapter I of chapter 81, chapter 84 (except to the extent specifically provided therein), and section 7902 of this title.

This subsection does not affect the status of these nonappropriated [sic] fund activities as Federal instrumentalities. (Employee, 1990)

While not paid using congressionally obligated funds, NAF employees are still considered federal employees and enjoy similar employment benefits as appropriated federal employees. NAF employees are placed into one of three pay scale categories: craft and trades (CT) pay band, child and youth (CY) pay band, or NAF white-collar (NF) pay band (Department of Defense Instruction [DoDI] 1400.25, 2024). Department of Defense Instruction (DoDI) defines these categories as:

a. CT Grade. The CT grade program occupational category covers positions in a recognized craft or trade or in an unskilled, semiskilled, or skilled manual labor occupation. Classify and pay employees in NAF CT positions according to Federal Wage System policies, systems, practices, and standards administered by the Office of Personnel Management (OPM). The OPM is responsible for the administration of the Federal Wage System, a uniform pay-setting system. NAF wage rates are established for each NAF

wage area in accordance with Subchapter IV of Chapter 53 of Title 5, U.S.C. See Table 2 for additional information on classification of CT positions.

b. CY Payband. The CY payband program occupational category covers assistants, leaders, and technicians in DoD childcare centers and youth programs. Further guidance on classification of CY positions is in Section 6 of this volume.

c. NF Payband. The NF payband program occupational category covers a wide range of clerical, administrative, recreational, resale, or managerial functions performed in settings such as an office or a service or retail operation. Further guidance on classification of NF positions is in Table 1 of this volume. (DoDI 1400.25, 2024)

Most available information on NAF employees is contained in government documents. Private literature and research material could not be found, indicating a gap in the study of new technology and processes, and how they impact government employees, a gap this effort intends to contribute to.

Automation and human resources are a key focus area of our research. Motivations for automation and potential impacts on human resource management, specifically the workforce. We explain the topics and motivations and potential impacts later in this chapter. In this section, we examine the removal process of a federal employee, which includes NAF employees, from the workforce. U.S. policy on the termination of federal employees is complex. It is complex because there are few reasons a federal employee can be separated from service, and even when the separation can be justified, the process is long and federal employees are afforded specific rights.

The following is a summary taken from DoDI 1400.75 and 5 Code of Federal Regulations (C.F.R.) Part 432 (DoDI 1400.75, 2024; Performance Based Reduction in Grade and Removal Actions, 1989; Adverse Actions, 2009). Federal employees can be separated due to performance or a business-based action (BBA). Performance related separations encompass several actions that combine to make a cumbersome process. First, the employer requires documentation on a specific deficiency in the employee's performance actions. After the documentation, the employer gives the employee an opportunity to correct performance deficiencies. If the employee does not correct the performance issues, then separation can be determined to be in the best interest of the

government with written notice of at least 30 days in advance. Following that, the employee has 30 days to respond. During this time, the employee has an opportunity to build a case and can seek legal representation. Once all facts are considered, a board may determine the course of action, which ultimately ends up on the desk of a decision authority who makes a final ruling. This is a simplified scenario of a complex process, but we want to highlight that removal a federal employee is challenging and requires careful planning, documentation, and consideration that needs to withstand a thorough appeals process (DoDI 1400.75, 2024; Performance Based Reduction in Grade and Removal Actions, 1989; Adverse Actions, 2009).

DoDI 1400.75 establishes BBAs as a mechanism the government can use to realign the workforce when economically required. BBAs are actions that allow non-appropriated fund instrumentalities (NAFIs) to reorganize the workforce to improve efficiency or address other issues, such as budget shortfalls and military base closures. In these situations, an advanced notice is preferred but can be waived based on timelines. Additionally, separations due to BBAs are more difficult to appeal, and the BBA process itself must be identified as flawed for an employee to successfully appeal because BBAs do not address performance or conduct issues, any adverse workforce actions because of automation will fall under the BBA category. These actions would fall under the "change to lower grade or pay band level," which can be a result of new technology and change in responsibilities (DoDI 1400.75, 2024).

b. Distribution Centers

Like their private sector counterparts, NEXCOM utilizes a network of primary DCs to stock smaller warehouses and brick-and-mortar stores. There are three main DCs that comprise NEXCOM's network and are divided geographically to distribute goods within a specific area of operation, as shown in Figures 1 and 2 (NEXCOM Manager, email to authors, March 5, 2024).

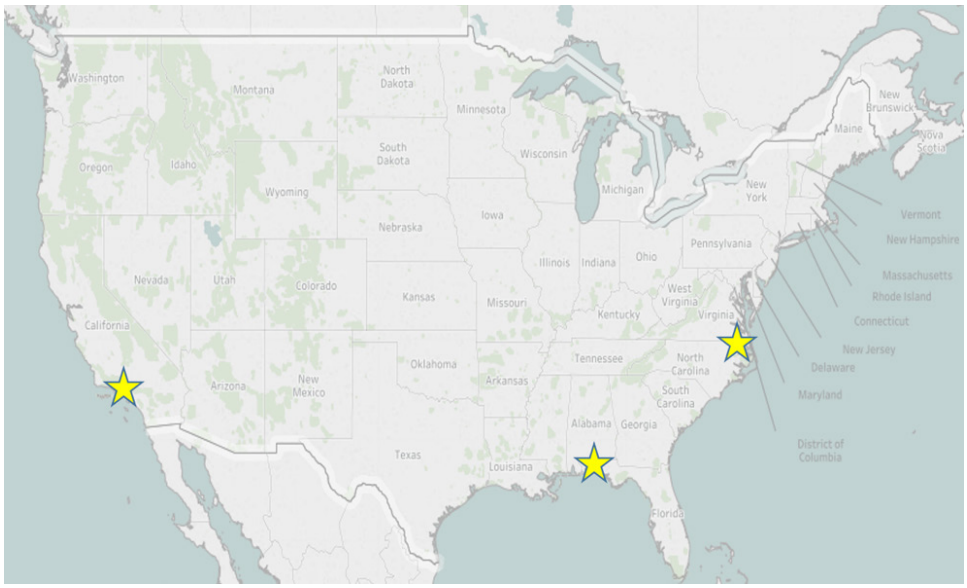

Figure 1. Distribution Center Layout. Source: Navy Exchange Service Command (NEXCOM) Manager (email to authors, March 5, 2024).

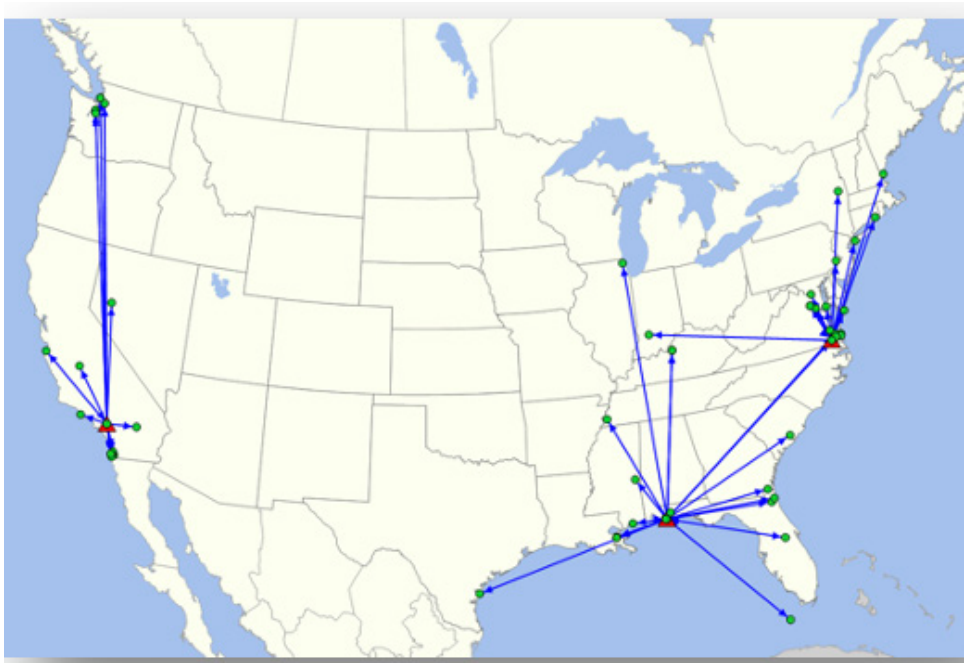

Figure 2. Distribution Center Regional Coverage. Source: NEXCOM Manager (email to authors, March 5, 2024).

The research does not focus on the complete network of DCs of NEXCOM but rather the WCDC in Chino, California. In emails received by the authors, the attachments

contained details about the WCDC (NEXCOM Manager, email to authors, March 5, 2024; NEXCOM Manager, email to authors, September 24, 2024). The WCDC is a 400,000 square foot warehouse segmented into smaller areas, as shown in Figure 3. The WCDC consists of one main DC, in Chino, CA and one satellite DC, in San Diego, CA, for a combined total of 521,000 square feet. The DCs serve 279 stores of various sizes. 166 people are employed at the WCDC. Of those, 131 (79%) are CT band and 35 (21%) are NF band NAF employees. Material shipped is valued at approximately $319 million, which is 28% of the total material issued among all NEXCOM DCs (NEXCOM Manager, email to authors, 5 March, 2024; NEXCOM Manager, email to authors, September 24, 2024).

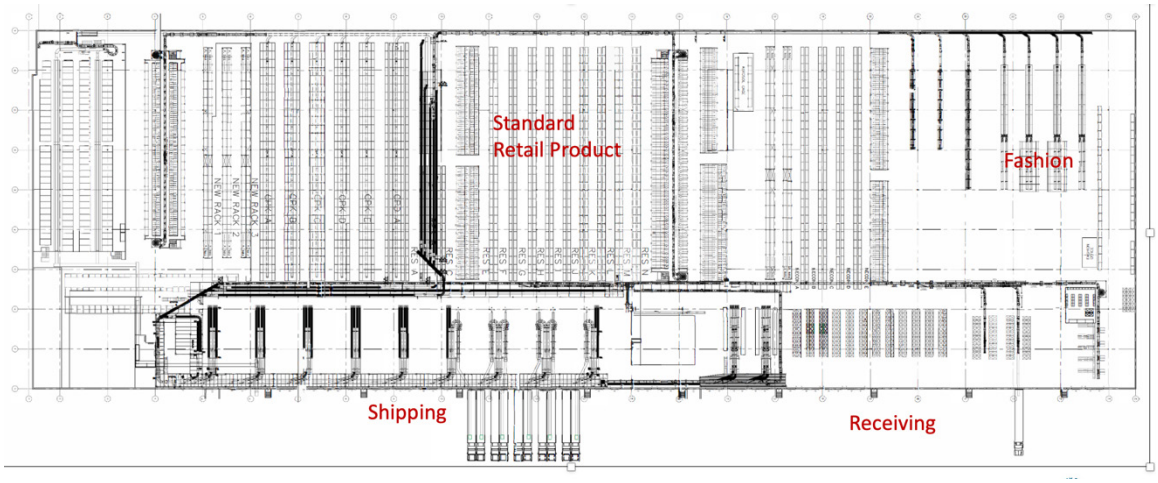

Figure 3. Chino Warehouse Footprint. Source: NEXCOM Manager (email to authors, March 5, 2024).

3. Current Automation Technologies and Concerns at the Chino Distribution Center

In 2021, NEXCOM and a consulting company assessed the status of the WCDC with NEXCOM management and proposed two general courses of action (COA) (NEXCOM Manager, email to authors, March 5, 2024). The first COA is to remain at the current location in Chino, CA and maintain the current operations while assessing the need to upgrade equipment as necessary. The second COA is to move forward with some level of automation at a new DC in the Chino area. The new warehouse would be approximately

500,000 square feet. Automation can be built into the new DC. From the assessment, NEXCOM analyzed three levels of automation: low, medium, and high. These levels of automation range in price from $22 million to $75 million, with medium automation being estimated at $41 million. Medium automation was selected as the most advantageous (NEXCOM Manager, email to authors, March 5, 2024). NEXCOM has conducted market research into upgrading the WCDC and identified several companies to address both COAs. From the attachment in the email received by the authors, NEXCOM identified the companies provide automation solutions ranging from low to high automation (NEXCOM Manager, email to authors, March 5, 2024). The research does not look in depth at the specific companies and solutions they offer for the WCDC.

C. INDUSTRY STANDARDS

NAVSUP has prioritized learning what private industry is currently innovating for operations (Stewart, 2021). The private sector has been implementing automation since the early 2000s, and there is ample literature on the subject. This section reviews published academic works that cover similar topics from general warehouse science to associated technology planning, adoption and innovation.

1. Importance of the Warehouse and Distribution Center in Retail Supply Chains

Innovation in warehousing is primarily driven by the demands of customers placed on retail organizations. We discuss that NEXCOM uses a network of DCs to serve stores that fall within their geographic area of responsibility. DCs, a type of warehouse, are unlikely to become obsolete and provide crucial support to retail networks.

In their definitive book *Warehouse and Distribution Science*, Bartholdi and Hackman (2017) established the warehouse as a significant capital expense and crucial piece of the retail network that most operations cannot operate without. The authors elaborated on specific uses of warehouses, which are to better match supply with customer demand and consolidate product. Both aspects provide indispensable benefits to retailers. Better matching supply with customer demand allows retailers to quickly respond to changes in customer demand. For example, a retailer's ability to surge during the holiday

season is possible because of the role of warehouses. Warehouses also provide a security net for changes in supply. The prepositioning of stock can protect a retailer from supply chain squeezes (Bartholdi and Hackman, 2017). Consolidating product enables a retailer to lower transportation costs, which are identified as fixed costs whenever material is shipped. Bartholdi and Hackman use Home Depot as an example for the role of DCs. Because of the number of vendors Home Depot uses sources their products from, it is not practical for vendors to ship to individual stores. Instead, Home Depot uses their warehouses to consolidate products from thousands of vendors, and Home Depot then provides individual shipments to their network of brick-and-mortar stores (Bartholdi and Hackman, 2017). Figure 4 illustrates the point that DCs simplify an otherwise complex network of operations between vendors and brick and mortars.

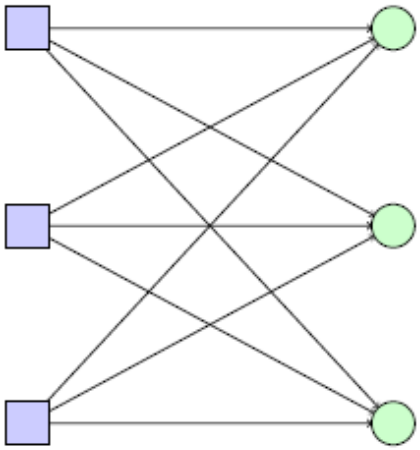

Figure 1.1: With m vendors and n stores the transportation plan consists of mn direct shipments, each relatively small and likely subject to the higher, less-than-truckload rates.

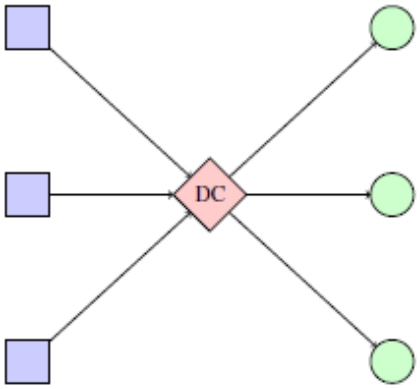

Figure 1.2: There are only $m + n$ shipments through an intermediate aggregator, such as a distribution center or crossdock. Furthermore, each shipment is larger and more likely to qualify for the lower, full-truckload rates.

The top portion of this figure shows complexity without DC, whereas the bottom of the figure shows simplified process with DC.

Figure 4. Visual Representation Relationship between Distribution Centers and Brick-and-Mortar Stores. Source: Bartholdi and Hackman (2017).

With the importance of warehouses established, Bartholdi and Hackman (2017) proceed to take a deep dive into the countless aspects of warehouse science, from basic definitions to detailed designs of optimal warehouses layouts. It is important to establish the difference between the types of warehouses, with five identified by the authors. First,

a retail DC simply supplies products to retail stores. Second, a service parts DC holds spare parts for expensive capital equipment. Third is an e-commerce warehouse which fills remote orders from individual customers. Fourth is a third-party logistics (3PL) warehouse, which is a warehouse operated by a third-party organization. Finally, there are perishable warehouses, which usually stock perishable items such as food (Bartholdi and Hackman, 2017).

Warehouse and Distribution Science is an invaluable source as it provides a robust starting point for our own research. It is key to establish the relevance of warehouses and the different types of warehouses so that NEXCOM and the WCDC can be easily understood and visualized by outside readers. This understanding allows us to outline the individual intricacies of NEXCOM operations and how their warehouse network fits within the broader discussion of retailing and warehouse network science.

2. Goods to Person

Order picking is a major component of warehouse operations and consumes the most labor (Bartholdi and Hackman, 2017). More specifically, Bartholdi and Hackman point out that travel time is the main factor in the labor dedicated to order picking with no benefit, stating "travel time is a waste: It costs labor hours but does not add value" (Bartholdi and Hackman, 2017, p. 157). This makes the order of order picking ripe for improvement with automated functions.

Literature about automation is ample, but not when it comes to the narrow topic of order picking automation. A 2021 literature review of the topic by Vivek Vijayakumar and Fabio Sgarbossa identified that, at the time of their writing, 47 articles about order picking exist. Of those 47 articles, only eight discuss automation in the order picking process, demonstrating gaps in the subject of order picking and automation (Vijayakumar and Sgarbossa, 2021).

In a 2007 article by Gu, Goetschalckx, and McGinnis, two methods of order picking are named and defined: parts-to-picker, and picker-to-parts. The naming refers to how material ends up in the hands of the picker. In parts-to-picker, the material is moved to the picker via methods that include automated storage and retrieval system (AS/RS) units or

carousels. Picker-to-parts refers to a more manual and labor-intensive process which involves the picker walking up and down aisles and manually retrieving material in a sequential manner.

Goods to person (G2P) is a similar process to parts-to-picker, where the material is brought to the operator rather than an operator retrieving the material. The G2P approach is emerging as a key element of warehouse operations, specifically e-commerce warehouses. From an article written by Banur et al., the authors discussed G2P in their 2024 article on the topic of robotics in the supply chain, of which warehouses play an integral role. Banur et al. (2024) argued that G2P can be well suited for e-commerce operations because of the high volume and customized nature of online orders, which require individual items to be picked and packed. In line with other literature on the topic of picking, this article further identified travel time of pickers as a major waste of warehouse resources and inefficient process, and one that can be addressed by automated solutions.

In addition to minimizing or even eliminating the waste of manual picking, robotic G2P is customizable and can be integrated into any operation and support different consumer demands. These systems are scalable and adaptable based on increased or decreased demand and customizable to warehouse design and operations (Banur et al. 2024; Huang et al., 2015).

3. Efficiency and Role of Cross-Docking

Taken directly from *Warehouse and Distribution Science*, "Crossdocks [sic] are high speed warehouses" (Bartholdi and Hackman, 2017, p. 219). The authors explained that the biggest reason to cross-dock is to reduce transportation costs. It is not just transportation costs that can be reduced. Because overall warehouse storage is reduced, so too are the costs of maintaining inventory. Material is moved rapidly from one truck to another and shipped directly to requesting stores or customers and in turn the labor costs of handling material are reduced (Bartholdi and Hackman, 2017).

Bartholdi and Hackman (2017) contend that cross-docks are versatile. They can be simple, comprising fewer than a dozen doors, or complex, comprising several hundred.

The layouts can vary as well, with the ideal shape being a long and narrow rectangle. Other layouts exist, including Y, U, I, and H shapes. This demonstrates that cross-docks are customizable and scalable and can be ready to transplant into a number of operations that are already established and functioning (Bartholdi and Hackman, 2017).

In a 2012 article, Jan Van Belle, Paul Valckenaers, and Dirk Cattrysse echoed Bartholdi and Hackman by claiming cross-docking "eliminates the two most expensive handling operations: storage and order picking" (p. 828). This article goes on to list several other advantages when compared to traditional DCs, including cost reduction, shorter delivery times, improved customer service, reduction of storage space, faster inventory turnover, fewer overstocks, and reduced risk for loss and damage (Van Bell et al., 2012).

In a 2019 article, Yassine Benrqya compared the difference between tradition warehousing and cross-docking, defined as "a distribution strategy in which the retailer DC operates as a transfer point rather than a storage point" (p. 412). Using a single case study approach, the article established four distinct scenarios between traditional warehousing and cross-docking to address two questions:

1. Is cross-docking more beneficial than traditional warehousing?
2. What is the impact of combining cross-docking and traditional warehousing in the same supply chain? (Benrqya, 2019, p. 414).

In answering these questions, the author established four distinct models that analyze varying degrees of traditional warehousing, cross-docking, and some fusions of both. The first model is AS-IS, which is traditional warehousing and the baseline of the study. The second model is TO-BE1, a "pick-by-line" strategy where orders are packed in bulk by the supplier and sent to the retailer, who will then split the bulk orders, repackage, and send to individual stores. The third model is TO-BE2, a "pick-by-store" strategy, where the supplier packs shipments based on individual store order and sends them to the retailer for shipping to the stores. The fourth model is TO-BE3, which is a hybrid of traditional warehousing and cross-docking (Benrqya, 2019).

The models represented by Benrqya's (2019) article are difficult to visualize based on the authors explanation. The researchers adapted the models to represent the explanation of the TO-BE1 and TO-BE2 models visually. Figure 5 refers to the TO-BE1 model, using

the example of 100 total shirts for three stores. Note the supplier simply sends 100 shirts to the retailer DC. From there, the retailer DC will divide the bulk order into three separate orders and ship to the stores. Figure 6 refers to the TO-BE2 the same number of total shirts, 100, but this time the supplier splits the bulk order into three separate orders and sends it to the retailer DC. The retailer DC will then send the three separate orders to the three separate stores (Benrqya, 2019).

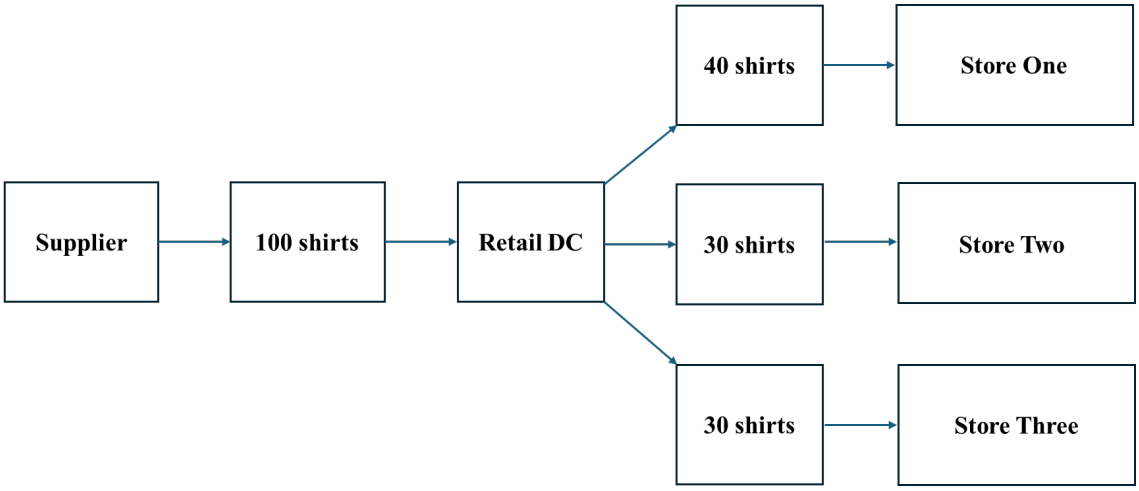

Figure 5. TO-BE1 Model. Adapted from Benrqya (2019).

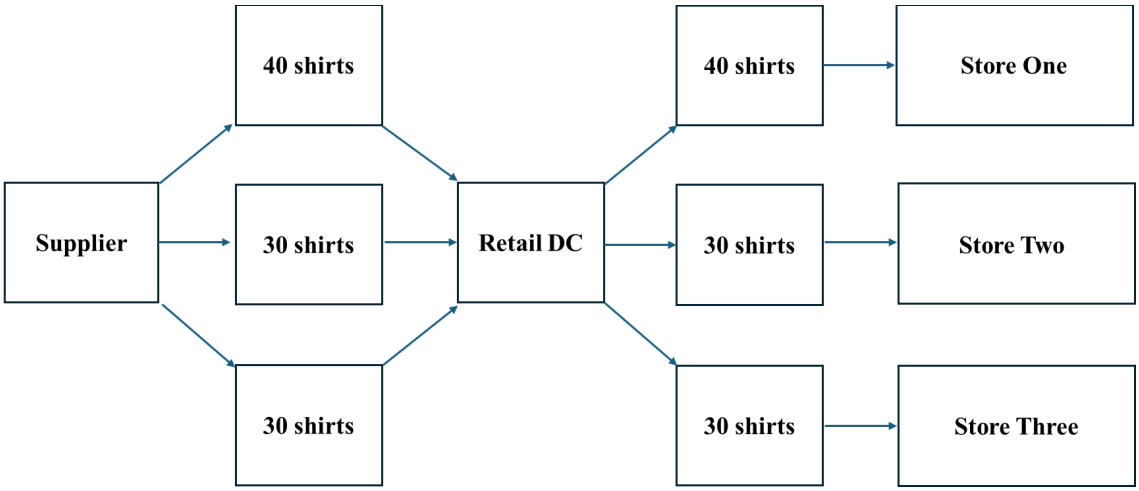

Figure 6. TO-BE2 Model. Adapted from Benrqya (2019).

The literature on cross-docking varies with some literature focusing on the technical details of layouts and transportation schedules. Others tend to focus on the benefits of cross-docking in various supply chain operations. Our study relies more on the latter as we are not concerned with the specific layout because a cross-dock can be as simple as a "slab of concrete with a roof and walls punctuated by doors for delivery" (Bartholdi and Hackman, 2017, p. 219). The key point of including cross-docking in the literature is to showcase that it is a viable option for supply chains and DCs, and if executed correctly, can have several advantages for a retailer.

4. Early Research on Planning, Implementation, and Challenges of Automation

Peter Baker and Zaheed Halim's (2007) research explored the significance of supply chains and the minimal amount of research in the logistics field about why companies are motivated to take on automated processes in their warehouses. The authors identified motivational factors associated with successful process improvement that led to complexities in the process improvement.

The Baker and Halim (2007) article explored the reasons behind the implementation of warehouse automation. The increasing volatility of the market is causing warehouses and DCs to shift the traditional practices of warehouses. The study used a survey questionnaire to research the nature and motivations of a company to

implement automated warehouse systems. It identified key motivation factors such as accommodating growth, cost reduction, and service improvement while indicating complexities of the implementation process. The companies that prioritized accommodating growth as a motivational factor, rather than cost and service, demonstrated a higher success rate of transitioning to an automated warehouse. The study noted the topic called for further review based on the limited sample size in the survey. The study concluded with a recommendation that the design process and operational management should proactively plan for automation based on long-term risks and business model, rather than a reaction to changing market conditions (Baker and Halim, 2007). Companies should not hinge the success of the warehouse automation implementation on a single motivational factor.

The Baker and Halim (2007) article provided a thorough overview of the fundamentals of warehouse automation. Supply chains are complex systems which the average person or novice reader may have difficulty understanding. The authors provided several examples of the roles of warehouses in the supply chain, to include cross-docking, product fulfillment centers, and returned goods depots (Baker & Halim, 2007). The article then examined the various types and roles of specific automation functions to give the reader an idea of what automation entails. A key argument was that the growing role of automation within supply chains and warehouses warrants more research to address the specific questions the authors intended to answer. The authors introduced three research questions: why companies automated and the concerns they may have in doing so, how companies automated and the length of time for implementation, and why certain projects were successful, and others were not based on motivation factors, in terms of successfully maintaining the ongoing operations and keeping to time and cost budgets (Baker & Halim, 2007). The author's research questions were broad in scope and can develop further research and inquiries to examine automation implementation. To address this, the authors narrowed down their focus to the two specific areas: potential impacts on customer service levels and longer-term flexibility.

Baker and Halim (2007) utilized a hybrid approach to address the three research questions. The methodology combined qualitative information of interviews to form a

qualitative survey questionnaire. The responses from the interviews developed their survey questionnaire to gather insight to generic planning steps for warehouse automation. The generic steps of the survey are classified into pre-project, implementation, and post-project phases. The survey was distributed to 32 participants and received 19 responses. The authors recognized the small sample size was not significant to warrant comprehensive quantitative review from the survey questionnaire. However, there is consideration in the sample size to analyze the information about the quantity, time scale, and planning steps to automation projects during the time of the survey questionnaire. Baker and Halim (2007) noted the information provided by both the survey and interviews was critical to understand the complexity and impact of automation during the time of the research. Responses to the survey questionnaire included several different scenarios ranging from automation in new buildings to upgrades to existing automation functions (Baker and Halim, 2007).

The Baker and Halim (2007) research presented some further considerations and interpretation of results. The author's results identified automation is primarily motivated by accommodating growth, followed by cost and service, and staffing levels. The results challenged the findings of a previous research survey, which concluded that these motivational factors were not significant. However, there may be subtle differences in the research approach and methodology that may explain the alternate conclusions (Baker & Halim, 2007).

Regarding automation projects, Baker and Halim determined that these are usually considered major projects. This is evident in the discovery that most companies assign a project manager and sponsor, and that these projects are handled at the director's level (Baker and Halim, 2007).

For timelines, Baker and Halim (2007) determined that projects have a range of five to 39 months; 22 projects surveyed indicated completion on time based on the company's business model and planned goals. Two projects surveyed had significant impacts impeding the completion. The main factor contributing to the completion delay was overrun budget costs and management of implementation schedule. It was discovered that automation projects have a significant impact on existing operations when complexity was not deliberately planned for. The most significant delay involved IT systems, which

have the most complexity and can lead to increased time and cost to the company. The complexity was based on integration of software with the equipment (Baker and Halim, 2007).

The results from Baker and Halim (2007) effectively addressed the research questions and provided compelling findings and additional areas that could be explored in future research projects.

5. Impacts of Automation in the Workforce

A 2023 article by Hannah A. Berkers et al. provided an in-depth examination of the potential impacts the introduction of robotic workers can have on the human workforce. Focusing on the relationship between robots and work design, the authors discovered positive and negative effects of a robotic workforce and highlighted some approaches that can offset the downsides of new technologies on human personnel. A key element of the research revolved around how technology changes work design, which is defined as normal day-to-day work activities assigned within a job (Berkers et al., 2023).

Berkers et al. (2023) used an inductive research strategy and case study approach, which used collected qualitative data to study the work design and robot dichotomy. Eight warehouses from six different logistics companies participated in the research. Twenty-four employees of varying positions took part in interviews that were unstructured and semi-structured. The semi-structured interviews focused on the two topics of work and robotic impacts to that work. Of note here is the particular attention paid to the pickers and packers, more junior and less skilled employees whose work was the most impacted (Berkers et al., 2023).

The findings in this article revealed some valuable insights into the effects of robotic technology in the work design of the human workforce. Of particular interest is the difference impacts robots made based on skill and hierarchy. Because robotic work is more manual vs. skilled, the impact was felt more by junior personnel such as pickers and packers. This impact on daily tasks was found to be primarily negative, work for the human personnel became "simpler and monotonous" (Berkers et al., 2023, p. 1863). The loss of work did not always translate to more work or different responsibilities. The complexity of

robots ensured that the junior and less skilled personnel did not have additional roles in the management of the robots. The example provided involved the "fine tuning of a robotic arm, dealing with errors, and maintenance were done by head machine operators, the innovation manager, and/or the robot supplier" (Berkers et al., 2023, p. 1863).

Central to the findings was the motivation and different planning processes the individual warehouses took. Building on the Baker and Halim (2007) article, the Berkers et al. (2023) article concluded that "all the warehouses in our sample were motivated to implement robots to increase efficiency: working faster and cheaper." Berkers et al. (2023) introduced two systems, the technical system and the social system. The authors explained the technical system is when work is designed around a robot, and a social system addresses whether the robot was designed to fit the demands of the employee. The idea ties directly into the warehouse planning and execution process, which is ripe with challenges. From the Berkers et al. (2023) study, most warehouses made decisions at the management level with little input from junior employees that would be most affected. Two warehouses, identified as "E" and "H," relied heavily on employee inputs and how robots could positively benefit the manual laborers, ensuring "robots took over the worst parts of the work of order pickers, namely pushing heavy carts, finding products, and walking large distances back and forth to the drop-off point" (Berkers et al., 2023, p. 1862). Most importantly, these considerations were thought of before the implementation of robotics and clearly demonstrate that thoughtful planning and execution can offset the negative impacts of robots in the work force.

Our research focuses on the motivations for automating. We argue that motivations driving automation are a crucial factor in the planning and execution process. The Berker et al. (2023) article provided an in-depth look at how robotics are assimilated into the traditional work force, whether positive or negative. The approach taken in the article provides a strong foundation of a human-robot case study that would prove valuable to our own research and methodology.

6. Review of a Swedish Case Study: Concerns and Challenges in Automation

The Baker and Halim (2007) and Berkers et al. (2023) articles provided a broad overview of organizational motivations and challenges involved with planning and implementing automation. A 2021 thesis from Jonkoping University, written by Joseph Varghese and Sony Saju provided a more granular view of these motives and challenges. The effort by the authors identified very specific challenges that provide valuable insight into our own research.

The research aimed to answer two questions regarding challenges of implementing automation and what can be done to mitigate these challenges. The authors used a qualitative approach via a case study conducted at a single warehouse. The methods of data collection were observations and interviews with warehouse personnel (Varghese and Saju, 2021). This method, as shown in this piece as well as the Baker and Halim (2007) and Berkers et al. (2023), established a qualitative and case study research approach as a premier method to analyze the motives, planning, implementation, and challenges of warehouse automation.

The motivational factors discussed by Varghese and Saju (2021) are not groundbreaking and are in line with other studies. The main contribution of this thesis was the categorical approach to the challenges, which were grouped into three types: organization, technical, and people. In total, thirteen challenges were identified, and ten applied to the warehouse in the case study. Four mitigation strategies were introduced and built upon the articles of Baker and Halim (2007) and Berkers et al. (2023). The strategies from their research included awareness and long-term planning, establish success factors and evaluation criteria, use of decision-support tools, and formalize an implementation plan and human resource strategy (Varghese and Saju, 2021). These strategies built the argument that the decision to automate created potential consequences, and that careful planning across multiple facets of the organization was required to ensure automation is successfully integrated into the workforce.

The Varghese and Saju (2021) thesis is relevant to our own research. Our research questions parallel this thesis, with the key difference being our research focuses on

government warehousing rather than private sector warehousing. The authors, Varghese and Saju, confirmed that the most appropriate methodology for this type of research was a qualitative case study that relies on observations and interviews. Their contribution to literature provides an excellent and easily replicated methodology to incorporate into our own research on the topic.

D. SUMMARY

This chapter reviewed federal NAF employee policies, the status of NEXCOM's DC network, and operational concerns and considerations for the WCDC with regards to automation. Next, we examined studies by Baker and Halim (2007) and Berkers et al. (2023), which established motivations behind automation projects. The Varghese and Saju (2021) thesis provides an in-depth case study that develops concerns and challenges behind automation projects at a single warehouse. Finally, we reviewed literature to introduce the concepts of G2P and cross-docking, which will be expanded on in Chapter IV of our research.

III. METHODOLOGY

This chapter provides the research methodology and validation methods to answer the research questions.

The methodology used a case study to investigate the factors of automation and robotics for WCDC. The researchers selected a case study to understand one specific aspect of the company, the warehouse operations and DC at NEXCOM. A case study was appropriate for the situation because there are multiple dynamics within a single setting using various data collection methods to obtain information (Eisenhardt, 1989). The essence of a case study was to explore the decision-making process and understanding the why, what, and how (Yin, 2003). The intention was to get a robust understanding of the motives behind NEXCOM's idea for integration. The case study examined the why, how, and what based Yin's case study definition (Yin, 2003). The researchers added the when and the who of the planning process and factors driving NEXCOM to integrate automation and robotics at the WCDC.

The primary data collection and analysis was qualitative. The researchers collected qualitative data by conducting a site visit at the WCDC and conducting formal interviews. The site survey aimed to understand and observe the operations and day-to-day processes at the WCDC. The interviews sought to engage with NEXCOM management, and any other stakeholders involved in the process. The researchers used secondary data from peer-reviewed literature to interpret the results of the primary data collection. The researchers utilized the primary and secondary data and approached the research questions through triangulation and member checking to get a thorough understanding of the research questions. In the literature review, Chapter II, and discussion and results chapter, Chapter IV, the research used the qualitative data from these chapters to interpret and analyze the themes of responses and information to substantiate against literature.

A. SITE VISIT AND OBSERVATIONS

The researchers conducted a site visit to the WCDC in Chino, CA. The one-day visit included a tour of the facility with visual observations. During the tour of the facility,

the researchers engaged in discussions with the WCDC General Manager and applicable floor supervisors about the warehouse operations. The tour of the facility was approximately four hours. The site visit provided a wholistic understanding and gathered information about the daily operations and processes. The researchers engaged in a non-participant manner under natural conditions. The engagement by the researchers was under natural conditions which did not interfere with the activities of the warehouse operations and operators at the warehouse to cause bias or react to our observations in the operator's activities (Kumar, 2011).

The researchers viewed observations at the WCDC through the lens of management for the planning considerations. The tour of the facility viewed and focused on areas that NEXCOM considered to implement automation and robotics in areas of concern at the DC. The observations aided in steering the further development and guidance of the interview questions.

B. INTERVIEWS

To explore the planning process at the WCDC, the group conducted interviews with management involved in the planning process. The interviews used a semi-structured format to encourage discussion and gather more insight into the decision-making process. The researchers chose to use semi-structured interviews to seek out and obtain descriptions of the situation from the interviewee and later interpret the responses of the discussion (Kvale, 2007). The semi-structured interviews allowed for a balanced approach to questioning with open and closed ended questions to facilitate a more fluid and dynamic conversation and address themes of the question with follow-on questions (Adams, 2015).

The researchers conducted two sets of formal interviews using a semi-structured interview approach to the questions. A total of three participants of NEXCOM management participated in the interview process. The researchers interviewed the three participants based on time and availability. The interviewed participants felt confident that they adequately represented the perspectives of the planning process despite the small sample size, and the researchers are confident that the interviewees provided comprehensive knowledge to answer the research questions.

To protect participant confidentiality, the researchers redacted the participants names in the research narrative and refer to them by job title. Furthermore, the analysis in Chapter IV did not include direct quotations from the interviews ensuring anonymity.

The first set of formal interviews was in-person with the General Manager of the WCDC at the WCDC in Chino, CA. The interview took place in a conference room setting in the WCDC after touring the WCDC. The interview was approximately two hours.

The second set of formal interviews took place on a phone call using Microsoft Teams with the NEXCOM headquarters' Logistics Manager and Operations Manager. The interview was approximately two hours.

The researchers recorded and transcribed each set of formal interviews with FireFlies.AI software. The researchers used this software to capture the interviews to review and replay the interviews to identify themes connected to the research questions. The researchers did not include the transcripts as an appendix to ensure confidentiality of information shared between the participants and the researchers.

The interviews covered a wide range of themes and topics to answer the research questions. The themes of the questions elicited information on the planning process and other relevant information to the research questions. The researchers categorized the questions to approach the multifaceted aspects of the planning process. The categories of questions are such: operations, company organization, vision and goals, automation and progression, and financials. The researchers sent the research and interview questions to the interviewees prior to the interviews to promote a more engaging discussion.

Informal interviews took place after the formal interviews engaging with the Operations Manager. These interviews ranged from thirty minutes to an hour based on further information required to answer the research questions. A total of two informal interviews took place through a phone call using Microsoft Teams. The style of the interviews was question and answer between the researchers and participants. The questions for the Operations Manager focused on the categories from the formal interviews.

The researchers conducted interviews focused on member checking. Member checking is a technique to illicit feedback from research participants about collected data

or interpretation of collected data (Motulsky, 2022). The researchers conducted two sets of interviews with an informal structure of question and answer. Each interview was approximately one hour and used a phone call through Microsoft Teams. The researchers asked open ended questions to engage feedback about the research.

The first set of the member checking interviews was with the Operations Manager, Logistics Manager, and WCDC Manager. The second set of the member checking interviews was with the Operations Manager, Logistics Manager, and Distribution Manager. Each set of interviews focused on how the researchers have incorporated themes and concepts from the primary and secondary data to answer the research questions. The researchers asked the participants four structured questions modified from McKim's strategy on member checking, which asked participants focused questions about the results and findings of the research (McKim, 2023). The researcher determined that McKim's strategy on member checking was valuable to the research because the strategy outlined concepts for researchers unfamiliar with the member checking process.

C. VALIDATION

The results from the case study produced an assessment of NEXCOM's planning process. This assessment of the research questions did not generalize or apply the findings to other companies or other government agencies. The researchers collected data to assess the planning process, to provide recommendations, and analyze the results of the WCDC to NEXCOM.

Triangulation is a strategy that enhances credibility and validity through a multimethod approach to answer a research question (Bryman, n.d.). The researchers used triangulation to investigate the NEXCOM planning process and to build confidence and support with evidence to answer the research questions providing multiple viewpoints. To focus the triangulation, this research used a subset of methodological triangulation to analyze the results, which refers to the use of more than one method or multimethod gathering of data (Bryman, n.d.).

The triangulation method can increase credibility and validity of the research findings (Noble & Heal, 2019). The data gathered provides various themes and concepts,

which allowed the researchers to connect the findings to the research questions. Triangulation strengthens the findings by connecting them from different sources. However, Noble and Heal (2019) identified making connection to the research questions a limitation about triangulation. The authors have noted there are challenges to effectively describe the findings from multiple sources in triangulation. While the findings are unique to the research, there may be inconsistencies when comparing the findings to different sources of data (Noble & Heal, 2019). Through triangulation, researchers may not always provide transparent explanations of how they synthesized the results.

The researchers strengthened the findings from triangulation by using member checking or participant validation as another means to interpret the data. Originally cited in Lincoln and Guba (1985), the researchers used member checking to enhance the rigor of the qualitative research ensuring there is accurate descriptions and no misinterpretation of the data by involving the participant or interviewee in the process. This methodology was chosen to increase the accuracy, credibility, and validity of the triangulation (McKim, 2023; Motulsky, 2021). The researchers engaged in discussion with the participants of the interviews and created more rigor and soundness to the research.

When used with triangulation the results provide more validity to the narrative by identifying errors, disagreements, or misinterpretations (Motulsky, 2021). Through member checking, the researchers engaged with the participants to create more constructive results and reduce errors from the primary data and interpretation of secondary data. This process provided a more insightful analysis and an increased accuracy and consensus of the results.

The researchers incorporated the participants of the interviews to review the totality of the research. The researchers viewed the participants as experts based on their employment and experience. The member checking process had two sets of interviews to assist in validating the data and results. The first member checking interviews began after the collection of primary and secondary sources to confirm the direction of the research. The participants reviewed a draft version of the research and provided their feedback. The second member checking interviews provided the participants with the interpretated results of the triangulation process. The participants reviewed a draft of the themes captured from

the interviews correlated to the literature review and a draft of the remainder of the research. The themes sent to the participants can be viewed in the appendix. During the second interview the researchers asked the participants a series of questions to understand the thoughts and opinions of the research.

Taken from McKim's (2023) strategy on member checking, the researchers asked the participants the following questions during the interviews. The researchers modified the questions to:

1. After reading through the literature and findings, what are your general thoughts and opinions on how the group approached the topic?
2. How accurately do you feel the findings captured the approach to the topic?
3. What other input can be added to the findings to capture the research questions better?
4. Is there anything you would like removed? If so, what do you disagree with and why? (McKim, 2023, p. 46)

The researchers understood the use of member checking had limitations on this research. This research conducted only two sets of member checking interviews and discussion. This limited the results and data interpretation to the participants' expertise and the information provided during those interviews. The research timeline limited the period for member checking to the remaining months of the research. Time constraints limited the member checking process to two sets of interviews, however, all participants provided feedback on the collected and analyzed information to validate and strengthen the research.

IV. ANALYSIS AND DISCUSSION

A. INITIAL DISCUSSION

In this chapter we discuss the results of our analysis. The results use literature, interviews, and observations to analyze the motivations, concerns, and challenges that the WCDC may encounter when advancing automation and implementing robotics. Additionally, we provide some other strategies to potentially enhance current warehouse operations. We propose methods that NEXCOM can consider maximizing ROI and minimizing the challenges for their long-term objectives.

We focus on three key concepts relevant to analyzing NEXCOM's motivations, challenges, and concerns within the context of NEXCOM as a federal entity and their mission scope. First, it is important to consider the NAF employee structure, and how the structure differs from the private sector. Second, financial considerations, specifically the long-term ROI horizon and how NEXCOM generates and utilizes profits. Third, we focus on the retail structure of NEXCOM and how it differs from private retail, specifically the comparison of size and purpose of the smaller stores.

As NEXCOM moves toward advancing automation, the organization encounters a unique challenge of managing the NAF workforce. As discussed in the background and literature review, the separation or reclassification of an employee's position can be a bureaucratic and time extensive process. NAF employees have specific federal rights regarding the separation process, a unique distinction not afforded in the private sector. For example, all 50 states are "at will" employment states, which means that employers do not have to provide any sort of notice or follow any external processes aside from federal or state laws to remove an employee. In this example, basic equal opportunity laws that protect specific classes must be followed, along with retaliation and whistleblowing laws (World Population Review, 2024). Outside of these very specific and protected scenarios, separation processes in the private sector are simple in contrast to NAF employees. The implementation of automation at NEXCOM does not affect the positions of NAF

employees in terms of separation or termination. The NAF employees may be affected in their work function, but the implementation does not displace the workforce.

Integrating and replacing jobs in the workforce can be a controversial subject. Automation has the potential to divide the workforce, management, and leadership. At the time of this research in 2024, a strike of shoreman protested the implementation of automation and other working benefits, which could potentially displace the workforce (Oladipo & Shepardson, 2024). The conflict is relevant to depict the dangers of planning for automation when a workforce opposes integration. The strike was not resolved between the union and longshoreman workforce with an undecided action on the automation topic. When interviewing NEXCOM Managers about the topic, the managers understand the challenges of the workforce and automation. To proactively address potential labor disruptions, NEXCOM management is collaborating with industry partners to identify and mitigate risks (NEXCOM Manager, interviews with authors, November 6, 2024).

NEXCOM understands implementing automation into their business model will not infringe on the workforce through job displacement, termination, or separation. Rather, their plan is to integrate the workforce with automation and retrain employees providing opportunities for new job functions when displaced (NEXCOM Manager, interviews with authors, August 23, 2024). NEXCOM leans toward a natural workforce attrition when managing the NAF workforce, which highlights the difficulty in how warehouse operations can be affected by workforce management and a key challenge faced by warehousing and automation implementation.

Second, NEXCOM's financial considerations are based on long-term horizon ROI business model. The long-term ROI is based on NEXCOM's mission to provide competitive pricing to customers and with less emphasis on profit margins. Also, NEXCOM utilizes profits differently than the private sector in the sense that profits are returned to the customer base in the form of MWR contributions, lower prices, and infrastructure modernization (NEXCOM Manager, interview with authors, August 23, 2024). When compared to the private sector, a financial contrast is that NEXCOM does not have shareholders, and profits are distributed back to the customer base and military community. The unique business model provides the capability to have long-term financial

objectives. When comparing NEXCOM's long-term financial objectives to the private sector, the researchers had difficulty obtaining private sector ROI objectives. There is limited publicly available data on private sector ROI and financial objectives. Generally, the private sector forecasts their ROI based on a shorter period for a capital project (NEXCOM Manager, interview with authors, August 23 & November 6, 2024).

NEXCOM utilizes its profits differently than the private sector companies. We analyzed and compared the two business models of NEXCOM and Walmart to analyze the relationship between shareholder and profit distribution, using back-of-the-envelope calculations and a hypothetical situation. Walmart has shareholders expectations to uphold, and in fiscal year 2025 had a dividend amounting to $.83-$2.49 per share (Walmart, 2024) at approximately 8.04 billion outstanding shares (Market Watch, 2024). Since NEXCOM does not have shareholders, it is difficult to determine the share price and dividends shareholders can receive. This analysis of the return of profits to stakeholders highlights the differences between NEXCOM and the private sector. If Walmart wants to return their profits to their customers, it could be done in the form of lower prices and benefits to their customer base.

Lastly, we discuss the concept of retail structure differences between NEXCOM and the private sector. Unlike the private sector, NEXCOM operates only a handful of large or flagship stores that resemble Target or Walmart. These large stores are located at fleet concentration areas, such as Norfolk, Pearl Harbor, and San Diego. Most of NEXCOM's stores are smaller stores that resemble convenience stores, such as 7-Eleven or local corner stores, or offer very specific mission-based items such as uniform components, essential items, and unattended "micro-marts." For this discussion, these smaller stores can be broadly classified as mini-marts. The mini-mart is not a new concept for NEXCOM, but it is for the private sector. Target started investigating the feasibility and development of a smaller retail store concept in 2012 and opened an initial urban location in 2014, near the University of Minnesota. Walmart also experimented with smaller store retailing in 2011, opening about 100 stores, but all were closed by 2016 (Dutton, 2024). The differences between NEXCOM and the private sector can be viewed as inverse models. NEXCOM operates a small number of large stores and a larger number of mini-marts. The private

sector generally operates a handful of mini stores, if any, and a larger number of traditionally large sized stores.

B. TRIANGULATION

The first part of our discussion and analysis utilizes triangulation by using a multimethod approach to validate our research questions (Bryman, n.d.). This multimethod approach uses literature review, interviews, and observations to form the themes of our results. Our approach starts with the motivations, concerns, and challenges identified in our literature review. We correlated concepts to our two interviews, and then used our observation to fill in any gaps and narrow down our analysis and discussion. Figure 7 represents a visual of our triangulation process.

In our discussion, we begin by discussing the motivations outlined in Baker and Halim (2007) and Berkers et al. (2023). We then analyzed NEXCOM's motivations and provided an assessment of how their motivations compare to Baker and Halim (2007) and Berkers et al. (2023). We proceeded to identify the concerns and challenges introduced by Baker and Halim (2007), Berkers et al. (2023) and Varghese and Saju (2021). During the concerns and challenges in Chapter IV, Section D of the discussion, we discuss the challenges that we identified as relevant to NEXCOM and weave them into the discussion using the concerns and challenges in the literature.

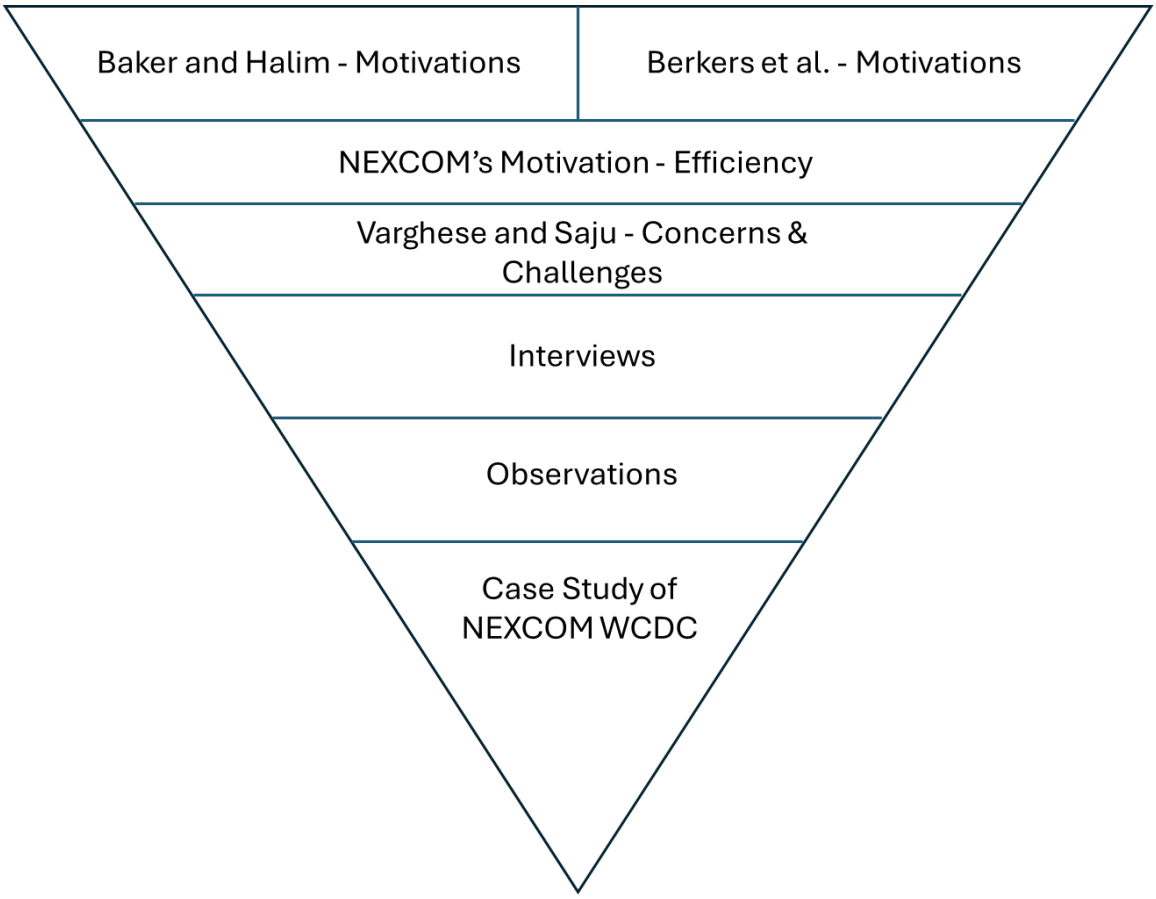

Figure 7. Aligning NEXCOM's Motivations, Concerns and Challenges with the Research

The research drew its understanding of motivations behind the decision to automate from two foundational articles, Baker and Halim (2007) and Berkers et al. (2023). After we identified and interpreted the motivations posed by the two articles, we attributed a motivation that best fits the case study of NEXCOM's WCDC. In addition to motivations, we drew upon concerns and challenges from the Varghese and Saju (2021) thesis. Using the thesis, we modeled the three categories, and 13 specific concerns and challenges identified in their research and applied the findings directly to NEXCOM (Varghese and Saju, 2021). After we identified motivations, concerns, and challenges from the literature, we reviewed the two interviews and synthesized themes to generate our own assessment. The Baker and Halim (2007) and Berkers et al. (2023) articles provided the foundation for understanding motivations and other factors for warehouse automation projects. We

connected NEXCOM's interview responses to the research question, focusing on themes we deemed as important. Using the Varghese and Saju (2021) article, we assessed the concerns and challenges relevant to the case study of NEXCOM. We then assessed whether NEXCOM has mechanisms to address and mitigate these challenges. When required the observations provided amplifying evidence to the literature and interviews.

C. MOTIVATIONS BEHIND IMPLEMENTING AUTOMATION

We set out to answer the following question: What is the motivation for a military retail store, specifically NEXCOM, to make incremental changes to manual processes by implementing automation and robotics in their distribution center? Gathered from Baker and Halim (2007), the primary motivation for retailers is to accommodate growth. This motivation can be framed in terms of capacity and how to grow capacity within the inflexibility of an existing warehouse. From the survey conducted by Baker and Halim, one respondent explained accommodating growth as "to prolong the operational life of a distribution centre, thereby delaying the need to close" (Baker and Halim, 2007, p. 132). Other motivations from their study include cost reduction, service improvement, and reducing staffing levels. Of note, the latter of these three motivations was an issue at key distribution centers in the UK (Baker and Halim, 2007). For example, a warehouse prioritizing cost savings as a primary motivation may face challenges integrating automation, as it narrows the focus and can overlook other motivations. The focus on one primary motivation has the likelihood to encounter issues hindering the integration process.

Motivational factors may have an impact on the success of automation projects, whether the intent is to add or upgrade to an existing DC or start over at a new DC. Baker and Halim (2007) identified two projects that faced significant disruption and overran budget costs. One of these two projects also overran their project schedule. A deeper look into these challenges from the projects revealed that the main motivations for automating were cost savings and staff reduction (Baker and Halim, 2007). Therefore, it is reasonable to conclude that specific motivations may have an impact on project success, as the only two warehouses that faced challenges in the study shared the same two primary motivations.

Berkers et al. (2023) examined eight warehouses, and in all cases, efficiency was cited as the main motivation behind automating certain functions. The article defined efficiency as "working faster and cheaper" (2023, 1860). We viewed this as a fusion of cost savings and accommodating growth.

NEXCOM has identified reducing labor on specific processes and increased responsiveness to customers as primary factors for automating (NEXCOM Manager, interview with authors, August 23, 2024). NEXCOM has recognized that because of their restricted customer base and minimal opportunities to grow, the most must be made with the available infrastructure. Additionally, NEXCOM could potentially remain at the current warehouse, which would force the organization to utilize existing infrastructure, thus prolonging the life of the WCDC. Using information provided by NEXCOM via internal documents, interviews, and observations, and the definitions provided by Baker and Halim (2007) and Berkers et al. (2023), we determined that NEXCOM's primary motivation behind automation is efficiency. Specifically, NEXCOM wants to reduce labor costs and maximize volumes in existing space to better serve their limited customer base (NEXCOM Manager, interviews with authors, August 26 & November 6, 2024).

Tying these motivational factors back to the private sector, NEXCOM is well suited to begin implementing an automation project. Note that NEXCOM is only looking to reduce labor on certain tasks, focusing on picking, and not reduce staffing levels. Staffing levels may go down naturally over time, but the intent is not to replace a human function with an automated function. NEXCOM has indicated that automated picking can replace the function of operators walking, and automation can remove the non-value-added time of operators walking up and down aisles (NEXCOM Manager, interview with authors, November 6, 2024). The motivation can potentially result in cost savings in terms of labor costs. Additionally, increased responsiveness to the retail stores by fulfilling the needs of the consumers can potentially generate more revenue. The intent is automation can provide flexibility to the warehouse to better respond to the demands of the retail store.

D. CONCERNS AND CHALLENGES OF IMPLEMENTING AUTOMATION

The second question the research sought to address was: how can challenges be mitigated by NEXCOM and the NEX distribution center in implementing automation and robotics? Automation introduces concerns and challenges that must be addressed and requires careful planning and mitigation strategies by NEXCOM.

Baker and Halim (2007) identified three main concerns and challenges when moving toward automation. The summary of these concerns and challenges for automation projects are project planning, concerns for warehouse automation, and causes of disruption (Baker and Halim, 2007). We interpreted the concerns and challenges from the article and applied them to NEXCOM. The following are concerns and challenges based on our research:

1. Project planning – initial planning, phases of the planning process, resources, scenario planning
2. Concerns – culture change, technology not working properly, flexibility, costs, service level dip (or warehouse operation throughput), and internal politics.
3. Causes of disruption – IT software integration, equipment installation, consolidation of sites, construction, impact on people, failure of system to work on time, equipment not performing as expected, and extended hand-over time. (Baker and Halim, 2007)

Berkers et al. (2023) focuses primarily on the human factors, which include how work is divided between robots and employees and what organizational level is involved in ideas and processes. A key piece in this article is whether automation is a technical system (robot centric) or a social system (human and robot centric) (Berkers et al., 2023). The bottom line in this article is that automation tends to have a bigger impact on a less skilled and labor-intensive work force. Therefore, organizations need to carefully plan automation projects to focus on incorporation of the workforce. Challenges in this process include task variety, left over tasks, physical demands, cognitive demands, and lack of autonomy and proactive behavior (Berkers et al., 2023).

In the Varghese and Saju (2021), their thesis split challenges into three broad categories: organizational, technological, and people. These factors are further broken down into 13 components. The thesis is a single case study like our research. Adapted from

the thesis, our discussion follows a similar approach to address each challenge and discuss the relevancy of the challenge, and if NEXCOM and our research address the challenge (Varghese and Saju, 2021).

From an organizational standpoint, the challenges that are present and need to be addressed are: commitment from top management, evaluation and economic justification, assessment of critical success factors, initial justification of the need for change, strategic focus and planning, and implementation of human resource strategic issues (Varghese and Saju, 2021). Of these six organization issues, we assessed that four of the challenges are applicable to the WCDC. Our interpretation of these categories identified four challenges: commitment from top-down management, evaluation and economic justification strategy, assessment of critical success factors, and human resource strategic issues.

An organization with a traditional hierarchy and dedicated roles requires top-down commitment for automation projects (Varghese and Saju, 2021). Our interpretation of top-down commitment was that leadership needs to be involved in automation projects, starting as early as the planning phase. The vision for automation must be promulgated by senior leaders in the organization. For NEXCOM and the WCDC, it started at the top with the Chief of the Supply Corp, Rear Admiral Epps. In a 2024 letter to the Naval Postgraduate School, Rear Admiral Epps identified warehouse automation as a high priority for the NAVSUP organization (Epps, 2024). This commitment applied to NEXCOM. An enclosure to the 2024 letter poses a specific research topic for Naval Postgraduate school students to research (Epps, 2024). This topic has been endorsed by retired Admiral Bianchi, the CEO of NEXCOM. Senior leaders and management working for retired Admiral Bianchi assisted greatly with our effort to address the warehouse automation topic (NEXCOM Manager, email to authors, March 5, 2024), which further shows NEXCOM's top-down commitment regarding automation projects. These senior leaders at the HQ and management at the DC level dedicated significant time to the study, which likely would not have occurred if this was not an important initiative for NEXCOM leadership.

Challenges in evaluation and economic justification strategy relate to how and when a project will pay for itself, and using that data, can the project be justified. Examples include rate of return (ROR) and payback period, which are typically determined by direct

labor savings (Varghese and Saju, 2021). These methods are applicable to NEXCOM and the WCDC. Through our interviews and observations, a major focus for NEXCOM and the WCDC was the use of automation to reduce labor hours, specifically for picking (NEXCOM Manager, interviews with authors, August 23, 2024). The labor hours spent picking and walking through the aisles can be shifted and prioritized to other tasks within the WCDC. These reductions in costs in the now automated picking tasks can potentially translate to money saved in the near term with the shift of labor. It can translate to some form of positive ROI or discreet near-term benefits for the WCDC. Due to the size and scope of their organization, NEXCOM recognizes this "payback" period will be longer than a private sector retailer. NEXCOM's business model uses a longer-term horizon than the private sector. The long-term ROI is acceptable to the organization.

The organizational changes brought about by automation are difficult to quantify and present a potential challenge to organizations (Varghese and Saju, 2021). In the article, the authors provided a scenario of a truck and delivery of merchandise. This scenario highlighted that their subject organization had difficulties adapting to demand signals resulting in inaccurate truck numbers. This scenario portrayed critical success factors surrounding changes brought by automation that are directly impacted by a company's ability to plan and adapt to other challenges outside of automation (Varghese and Saju, 2021). In the case of NEXCOM and the WCDC, we applied the concept derived from the scenario to the success of other initiatives. During our site visit, we observed multiple efforts to change operations at the WCDC and improve efficiency such as automated cleaning functions, more efficient manual cleaning functions, automated floor loaders, and a re-routing of foot and forklift pathways. These changes are minor when compared to the automation project considered but resulted in considerable improvements to the DC operations. These successes show that, while the challenge of critical success factors and changes brought by more advanced automation may exist at the WCDC, leadership is well suited to mitigate any significant impacts.

Justification of the need for change can present challenges. Varghese and Saju (2021) argue that this specific challenge arises from how a company determines to automate, specifically whether the decision was centered around a stakeholder's

contributions to profit or organizational benefits of new technology. In other words, does the decision come down to individual motivation and success, or success of the organization? Like the Varghese and Saju case, our study indicates that NEXCOM made the decision based on overall success of the organization and not a single stakeholder or employee within the organization, therefore we assess that this specific challenge is not applicable to NEXCOM and the WCDC (Varghese and Saju, 2021).

Strategic focus and planning centers on whether an organization is aware of technology capabilities and can adjust the organization around these capabilities (Varghese and Saju, 2021). Put another way, is the organization aware of the change technology can bring to the organization? If not, that is where the challenge can arise. NEXCOM has identified very specific areas where automation will be implemented and what that will mean for the workforce. This topic is discussed in depth in later challenges, but put simply, NEXCOM is aware that the WCDC will operate differently with new technology, and they are prepared to adjust accordingly, therefore this challenge does not exist in our case study.

Human resource strategy issues tie directly into the strategic focus and planning challenges addressed in the previous paragraph. Automation brings changes to the workforce, such as new or different skills, positions, or titles, and if the organizational changes are not recognized by leadership, they can present challenges with automation. We assessed NEXCOM leadership is very aware of the human aspect of these projects and places a huge emphasis on ensuring the workforce is considered. NEXCOM does not intend to remove employees based on automation implementation. NEXCOM intends to leverage the workforce to do the work required and reduce labor requirements to reduce overall labor costs. The only actions available to the organization to remove an employee are BBAs and well-documented adverse performance. Instead, NEXCOM will rely on a strategy of natural attrition, allowing the workforce to reduce via quitting or separating, retirement, or reassignment. Additionally, NEXCOM knows that existing functions of job positions will be adjusted. For example, while the intention is to reduce travel time for pickers, pickers will still have a job to "supervise" the automation or automated task. This change is not something new to NEXCOM or the WCDC (NEXCOM Manager, interviews with author, August 23, 2024). As discussed earlier, one automated function that the

WCDC has incorporated is automated cleaning. The WCDC introduced an automatic floor scrubber that has reduced the human labor of that function by an estimated 66% (NEXCOM Manager, interviews with authors, August 1, 2024). The WCDC did not replace the employee responsible for scrubbing the floor, but instead changed the employee to a new role of directing and maintain the automatic floor scrubber. We have determined that human resource challenges will not be a significant challenge for NEXCOM or the WCDC.

Data and service security is a challenge posed by the vulnerability of operating new systems and software (Varghese and Saju, 2021). During interviews with the authors, the topic of this challenge was discussed that automation can bring about network and software changes at the WCDC (NEXCOM Manager, interview with authors, August 1, 2024). Therefore, there are potential challenges that may exist. However, the authors and NEXCOM management determined the topic was not a major focus of our research and therefore was not discussed at length with NEXCOM leadership.

Challenges with new technology and training exist because of a knowledge gap between operators and the new technology (Varghese and Saju, 2021). As discussed, NEXCOM has a track record of implementing other forms of automation, therefore while there will be challenges associated with more advanced automation, NEXCOM and the WCDC have a positive track record of adjusting to these changes.

Varghese and Saju (2021) identified flexibility of a system as a potential issue. Defined as the ability of a system to adapt to new or changing environments, (Weber, 2004). The challenge of flexibility can be applied to NEXCOM, not in the defined sense, but in the system's ability to be incorporated into the existing infrastructure and organization construct. During their initial market research, NEXCOM leadership has determined that the systems they are examining can be easily incorporated into the existing infrastructure (NEXCOM Manager, interview with authors, August 23, 2024). The automation systems are not confined by warehouse layouts and structural impediments. It was discussed during the interview with NEXCOM, and it was determined that the design of the warehouse does not limit the picking automation function or capacity and can be

easily added to the existing operation. As a result, this challenge does not apply to our research at the WCDC.

System reliability can be a major concern when implementing automation (Varghese and Saju, 2021). Our thesis did not research the system reliability or inquire with NEXCOM leadership on their concerns regarding reliability. As such, we cannot confirm if this concern or challenge exists within NEXCOM and the WCDC.

Our discussion and analysis have touched on the human factor of implementing automation. One specific challenge that Varghese and Saju (2021) focus on is workforce resistance to automation. This challenge is recognized by NEXCOM leadership (NEXCOM Manager, interview with authors, August 1 & August 23, 2024). During the interviews, leadership and management portrayed some employees may be more inclined to resist organizational change, and NEXCOM has an idea of how to address the challenge internally. The researchers did not inquire how NEXCOM would resolve the conflict, rather inquired if the organization identified the challenge. The mentality of organizational change is a topic that NEXCOM management and the WCDC leadership may need to monitor and mitigate when automation is implemented in their operations.

E. OTHER CONSIDERATIONS

During our research on the motivations, concerns and challenges behind automation, we observed other areas where NEXCOM can improve operations. We sought to answer our third research question: Beyond robotics and automation, what strategies can NEXCOM and the NEX implement to improve and enhance existing operations? We determined two separate considerations that can be applied to NEXCOM's WCDC: one involving automation and one not involving automation. These strategies can be considered to further improve efficiency, thus fulfilling NEXCOM's primary motivation behind automation. The first of these, an expanded e-commerce inventory, can utilize the G2P approach NEXCOM is already planning, and better utilize it to create a higher ROI. The second is cross-docking, which NEXCOM is well suited for and requires little to no additional cost to implement but has the potential for significant cost savings.

1. G2P and Expanded e-commerce

G2P is the process by which material is brought to a picker at a single location (Banur et al., 2024) The key benefit is the reduction in travel time of the workforce, with automation making most of the material picks and consolidating material for the workforce. An additional benefit of G2P is a reduction in human labor hours which can result in cost savings.

NEXCOM is pursuing a G2P solution as the main automation project for their warehouses. Separate from NEXCOM, we identified multiple companies that can provide G2P solutions that can reduce labor hours by replacing human labor with automated labor. During our observations, one of the more labor-intensive processes was the unit picking section, a portion of the warehouse where the workforce traverses up and down aisles to pick material in the traditional sense. This area is the focus of NEXCOM's automation efforts at the WCDC (NEXCOM Manager, interview with authors, August 23, 2024). Because the WCDC handles many unit picks for shipments, a G2P solution is a viable solution to reduce labor hours (Banur et al., 2024). The NEXCOM's intent for G2P is to not reduce the total labor hours of the workforce, however, they want to reduce the labor hours required for picking and reallocate the labor hours spent picking to another task.

While utilizing a G2P approach to alleviate the burden of unit picking will result in reduced labor and cost savings, limiting the G2P approach to this function misses a major opportunity for better utilization. Currently NEXCOM operates one e-commerce only DC in Kentucky within their distribution network. We illustrate the e-commerce DC in the NEXCOM distribution network by explaining how material flows in their network. If an order is placed in Monterey, CA, approximately 350 miles from the WCDC, the order will be fulfilled and shipped from Kentucky, even if the item is inventoried at the WCDC. The WCDC might even ship the item to Kentucky to then be shipped to the consumer. This is an inefficient use of e-commerce and a missed opportunity for NEXCOM and the WCDC to benefit from the capital investment of an automated G2P solution. The e-commerce model is an ideal environment for a G2P solution (Banur et al. 2024). Our research did not focus on the internal network or processes of the WCDC, but if NEXCOM could convert

a portion of the WCDC to act as an e-commerce DC, the G2P solution could prove even more cost effective.

G2P technology can be seen as a positive investment when looking at the negative costs of order picking. Order picking, which is considered a "labor intensive time wastage" (Banur et al., 2024, p. 7) accounts for 50–55% of all warehouse labor costs. Breaking this down further, travel time for picking can account for 55–80% of a picker's time (Aldorando Valle, 2019; Bartholdi and Hackman, 2017). Any process that can alleviate these costs may be a benefit to an organization, and G2P projects can be viewed as one of the ways to cut down on these costs.

2. Cross-docking

In the case of NEXCOM, cost savings can be achieved without costly automation projects that may require extensive payback periods to obtain an ROI. Our proposed solution encountered in the research is cross-docking, a method of distribution where material received by a DC is immediately placed on a truck to the destination.

Based on our analysis and literature reviewed, the WCDC currently operates as a hybrid of AS-IS and TO-BE1. We discussed the cross-docking models in Chapter II. The WCDC is very heavy on traditional warehousing processes, but some cross-docking functions exist, called advanced shipping notice (ASN). The WCDC is currently operating their receiving department with this ASN model in which vendors provide an invoice of merchandise shipped to the DC (NEXCOM Manager, interview with authors, August 1, 2023). The shipment of prepackaged merchandise, without being broken down at the WCDC, is then directly shipped to the individual store.

Not all vendors utilized by NEXCOM qualify for ASN, which is the TO-BE2 process examined earlier in the cross-docking section of Chapter II. The TO-BE2 model has the supplier packaging shipments based on individual store requirements, not the total of individual store orders. Our observation was that additional items can be shifted to the TO-BE2 model, thus minimizing the labor-intensive processes currently used at the WCDC. This could bring the WCDC closer to the TO-BE3 model that Benrqya (2019)

outlines, which is a hybrid model where 70% of material is cross-docked and 30% is stored via traditional warehousing methods.

We observed two situations at the WCDC where traditional cross-docking could provide impact and benefits. The first was the fashion department. It was observed that multiple workers were required to break down vendor orders and then create individual store orders for shipment. This is a labor-intensive process that could be eased by a traditional cross-docking solution. Second, the breakdown of shipments in the receiving area, specifically shipments containing toiletries, could be improved. Once received, a toiletries pallet is broken down and sorted into several other pallets. Here, orders for individual stores are created for shipment.

In the situations above, we observed that orders from the individual stores are consistent. The WCDC tracks an individual store's requirement and ships the items on a regular basis. The quantities vary from store to store with some stores receiving one individual item, such as a single toothbrush or specific toiletry product. Regular shipments with little variation are prime candidates for cross-docking. Rather than receiving orders based on the total store requirements (TO-BE1), the WCDC can receive customized orders from the supplier based on individual store requirements (TO-BE2).

Another beneficial aspect of cross-docking is that it can be implemented at the WCDC with minimal capital investment. Bartholdi and Hackman (2017) identified the ideal layout as a rectangle shape or floor plan. This ideal layout is the exact shape of the WCDC. The layout of the current DC does not have to be modified to accommodate cross-docking. NEXCOM already uses a large labor force for fashion and toiletry operations, so the workforce exists to transition into a more cross-dock centric operation.

Some potential limitations do exist with moving toward a cross-docking operation. During our observations from the site visit at the WCDC there was the potential for incorrect inventory being shipped by the supplier. This would result in a store getting more or less than what is required. As discussed earlier, most NEX stores are small and have little room for excess inventory, so if too much is received this could disrupt store operations. Conversely, the stores could receive less than is required, and NEXCOM would

have to absorb these costs. Also, our research did not focus on what it would take for NEXCOM to convince vendors to shift to a TO-BE2 model, so there are potential challenges that this solution does not address.

The benefits of cross-docking are well researched. Walmart, the first retailer to introduce cross-docking, lowered costs by 2–3% compared to the average retailer (Ladler and Alpan, 2015; Van Belle et al., 2012). A retailer that wanted to implement cross-docking at a DC can reduce handling by 38–64%, inventory costs by 64–100%, and total supply chain costs by up to 6.4% (Benrqya, 2019).

F. MEMBER CHECKING

To validate our analysis and results, we utilized the member checking process. This process engaged with the interviewed participants, NEXCOM management, to provide results of the research. The participants were viewed as experts based on their employment and experience to provide input to the interpretation of primary and secondary sources. The member checking process comprised of interviews, analyzed versions of the draft research, and discussion about the results. The results of the research can be found in the appendix. The interviews took McKim's (2023) strategy to conduct the member checking process, and several questions were asked to the participants about the drafts of the research and their viewpoints of our interpretation.

The participants agreed that the researchers answered the research questions. The participants agreed with the thoughts and discussion from the primary and secondary sources captured the themes of the research questions. The participants agreed the researchers understood the NEXCOM scope and mission for the WCDC were in line with the efforts of their organization.

The participants did not agree with some specific terminology and nomenclatures related to NEXCOM, specifics to cross-docking that are applicable to the WCDC, e-commerce inclusion for the WCDC, continuous process improvement (CPI) status, and minor edits to wording for some key concepts related to NEXCOM. The biggest disagreement between the participants and researchers was the considerations for NEXCOM. The disagreement was in the applicability of the considerations for the

NEXCOM business model. The researchers proposed the other considerations, cross-docking and G2P for e-commerce, based on our review of the literature and observations at the WCDC that could potentially improve NEXCOM operations. The participants agreed the considerations from the researchers provide benefits to warehouse operations. However, the participants did not entirely agree with how the researchers applied the considerations to their business model and the WCDC. The participants did not agree that adapting the WCDC to a more traditional cross-docking model because the model does not currently fit with the NEXCOM business model; the G2P e-commerce inclusion at the WCDC is not currently feasible because NEXCOM is considering future applications for their e-commerce DC.

The participants did not have additional content related to warehouse operations to add to the research at the time of the member checking interviews. The participants were involved in the initial planning of the research, so any input was added through informal interviews. However, the NEXCOM management wanted to highlight from interviews that automation and robotics implementation is a challenge for a low volume retailer with worldwide presence (NEXCOM Manager, interviews with authors, November 6, 2024). Many companies in the private sector do not expand outside of the United States, but NEXCOM has retail stores in locations only military reside worldwide. For a retailer to begin incremental steps for automation, some considerations and challenges are approached differently than the private sector-long-term ROI, motivations for efficiency, G2P for picking small orders, and a federal workforce.

The participants did not have any themes or general concepts removed from the research. Again, the NEXCOM management's general thoughts concluded the researchers answered the research questions adequately.

The use of member checking had limitations for this research. The sample size was small, comprised of 3–4 participants in each set of member checking interviews. One participant was not available during the semi-structured interviews due to availability, but the participant was included in the member checking interviews. The participants involved in the research were focused only on NEXCOM management, and other personnel in the organization were not involved in this process, such as warehouse operators and other

stakeholders inside NEXCOM. The researchers had full participation from the initial semi-structured interviews in the member checking process. There was a time constraint for the member checking process, which shortened the window to allow for more discussion about the results.

To conclude, the member checking process strengthened the research. The process was beneficial because it involved full participation from the NEXCOM management interviewed. The participants concluded the researchers answered the research questions adequately. The member checking process validated our research results about NEXCOM.

In this chapter we discussed the results of our analysis. The results used literature, interviews, and observations to analyze the motivations, concerns, and challenges that the WCDC may have encountered when advancing automation and implementing robotics. Additionally, we provided some other strategies to potentially enhance current warehouse operations. We proposed methods that NEXCOM can consider maximizing ROI and minimizing the challenges for their long-term objectives

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V. CONCLUSION AND FUTURE RESEARCH OPPORTUNITIES

NAVSUP and NEXCOM plan to prioritize automation and robotics in their warehouses and distribution centers (Epps, 2024). This research sought to understand why a military retailer, NEXCOM, would be motivated along with the concerns and challenges for implementing automation and robotics at their WCDC. We conducted an overall assessment of NEXCOM's planning approach based on literature review and analysis of the data. Furthermore, we determined NEXCOM has approached the implementation of automation and robotics as successful. This qualitative case study produced valuable insights into the complexities of the planning process for a military retailer and its distribution center.

We used literature, interviews, and observations to analyze data and understand the planning approach for NEXCOM. This research sought to answer the following research questions:

1. What is the motivation for a military retail store, specifically NEXCOM, to make incremental changes to manual processes by implementing automation and robotics in their distribution center?
2. What are the concerns and challenges for the NEXCOM West Coast Distribution Center in the planning approach to implementing automation and robotics?

We concluded our research by providing a summary of review and assessment for the NEXCOM planning approach to implementing automation based on the results and literature review. We discussed the limitations of the researcher's analysis, and areas that can add to the body of knowledge.

A. FINAL OBSERVATIONS AND CONSIDERATIONS

Our research also sought to answer our third research question: Beyond robotics and automation, what strategies can NEXCOM and the NEX implement to improve and enhance existing operations? During our research, we identified two considerations. The

first is the expansion of e-commerce operations into the WCDC, which will more effectively utilize NEXCOM's consideration for a G2P automation approach. The G2P approach can potentially benefit the current WCDC operation based on the quantity of unit level picks, however the ideal operation for this technology is to have a robust e-commerce model. The second consideration is cross-docking. The cross-docking process can be implemented in the current infrastructure and requires minimal investment with the potential for significant cost savings for warehouse operations. The WCDC currently has limited cross-docking capability, in the form of their ASN model, and the addition of more suppliers to ASN could move NEXCOM closer to a true cross dock model, possibly saving storage and transportation costs.

B. CHALLENGES, LIMITATION, AND AREAS FOR FURTHER RESEARCH

The challenge for the research was the limited qualitative body of knowledge for retailers and warehouse operations, specifically towards the motivations, challenges, and concerns of implementing automation. The scope of research about the quantitative models of automation is abundant but limited qualitative understanding about why companies are shifting toward automation. The reasons why a company should adopt advanced automation were apparent to the researchers based on trends of the industry through the benefits and competitive advantage the industry claims. However, the challenge was identifying why these companies are motivated to do so outside of the monetary value. Narrowing this idea further was the challenge of why a military retailer outside of the private industry would adopt advanced automation in lieu of monetary benefits and a competitive advantage. The research revealed NEXCOM was motivated to implement automation for increased efficiency.

Our research was limited in multiple ways. First, we conducted a single case study which focused on one DC in the NEXCOM distribution network. The case study narrowed the scope of motivations, concerns, and challenges that NEXCOM faced as the company transitions towards advanced automation. The results from the case study limit the generalizability to other DCs in the NEXCOM network or to other companies in the private sector undergoing automation transitions. Second, a compressed research timeline, which

constrained the interview sample size to a limited number of stakeholders in the planning process focused on the management perspective. Though the researchers identified the individuals interviewed are considered experts within their field, further research considering the implementation of automation on warehouse operators within NEXCOM's distribution network and external stakeholders outside of NEXCOM, such as NAVFAC, would have proven valuable if time afforded the opportunity. Third, the research did not investigate other factors into why NEXCOM was motivated to implement automation. The research did not fully capture the influence of external factors such as economic conditions, DC supply chain, labor market trends, and recent technological advancements in regard to artificial intelligence.

Our research was focused on a single DC within the NEXCOM enterprise, and the observations and considerations cannot be applied to other DCs or warehouses within NEXCOM or NAVSUP. Future research opportunities do exist in other organizations within the NAVSUP enterprise (Epps, 2024). Some other considerations for further research can apply a qualitative study to the perspective of the warehouse operators and the incorporation of automation, and how automation affects their job and functions. A quantitative study can research the ROI once NEXCOM has implemented the automation and how successful the ROI was based on their long-term financial objectives. Our study has further applications to research the NEXCOM and NAVSUP enterprises as the organizations pursue warehouse automation solutions.

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APPENDIX. SUMMARY OF RESULTS FOR MEMBER CHECKING

- Motivations for implementing automation.
    - Cost savings, labor reduction, accommodate growth, and customer service (Baker and Halim, 2007).
- Efficiency – cheaper and faster (Berkers et al., 2023).
    - Through our observations and interviews, we conclude that NEXCOM is implanting more advanced automation for efficiency (save money = cheaper, reduce labor hour = faster and cheaper).
- Concerns and challenges.
    - Culture, technology, flexibility, cost, services, and politics (Baker and Halim, 2007).
    - Work design – tech system vs. social system (Berkers et al., 2023).
    - Organizational (top-down commitment, evaluation and economic justification strategy, assessment of critical success factors, initial justification for change, strategic focus and planning, and implementation and HR strategic issues) (Varghese and Saju, 2021).
    - Technological (data and security service, tech introduction and training, flexibility, and reliability) (Varghese and Saju, 2021).
    - People (worker resistance, change in worker skill, and communication challenges for operators) (Varghese and Saju, 2021).
- From a Baker and Halim (2007) standpoint, we assess that four of the challenges are applicable to NEXCOM (Culture, cost, service, and technology) and that of

those four, three have been positively addressed (culture, cost, and service). We determined flexibility and politics were of minimal or no concern.

- Berkers et al. (2023) identified four areas of concern, all of which were applicable. Task variety and physical demands have been addressed. Cognitive demands and lack of autonomy and proactive behavior are known but are not the focus at the time of writing.
- Varghese and Saju (2021) provide a comprehensive list of potential challenges during the implantation of automation. We identify each as applicable and/or addressed.
    - Top-down commitment – Applicable and addressed (NAVSUP and NEXCOM leadership engagement via NAVSUP letter to NPS students, CEOs vision, and NEXCOM support in our research) (Epps, 2024; NEXCOM Manager, email to authors, March 5, 2024).
    - Evaluation and economic justification strategy – Applicable and addressed (internal (CBA) and external (St. Onge) analysis) (NEXCOM Manager, email to authors, March 5, 2024).
    - Assessment of critical success factors – Applicable and somewhat addressed (we have determined that it is early in the planning process and not a key area that needs to be addressed at this time) (NEXCOM Manager, interview with authors, August 23, 2024).
    - Initial justification – Not applicable.
    - Strategic focus and planning – Applicable and addressed (Several factors have been addressed including potential companies, employee impact,

specific areas of implantation, and flexibility with adding to existing infrastructure) (NEXCOM Manager, interview with authors, August 23, 2024).

- Implementation and HR strategic issues – Applicable and addressed (NEXCOM has addressed HR goals and concerns, robots will not replace people, but natural attrition is expected and desired over time) (NEXCOM Manager, interview with authors, August 23, 2024).
- Data and security service – Not applicable.
- Tech introduction and training – Applicable but not specifically researched on our end (NEXCOM Manager, interview with authors, August 23, 2024).
- Flexibility – Applicable and addressed (NEXCOM has addressed flexibility in two areas: ability to meet demand surges and flexibility with adding to existing operations) (NEXCOM Manager, interview with authors, August 23, 2024).
- Reliability – Not applicable.
- Worker resistance – Applicable but not a major focus of our research. (NEXCOM Manager, interview with authors, August 23, 2024).
- Change in worker skill – Applicable but not a major focus of our research. (NEXCOM Manager, interview with authors, August 23, 2024).
- Communication challenges for operators – Not applicable.

- **Other considerations**
  - Despite the literature arguing that G2P is best suited for e-commerce DCs, we see the value added at the WCDC because of the heavy reliance on unit

picking/packing and the process of unpacking and reassembling material on new pallets. A focus here could ensure success if e-commerce is to be shifted to all the DCs vs. being located at a single DC (Banur et al., 2024).

- The WCDC does not currently have any continuous process improvement initiatives ongoing, but the benefit of shifting to a true cross-docking model is simple and should not be overlooked. Cross-docking can be implemented at the WCDC and moved if operations shift to a new warehouse.
- If NEXCOM's goal is to reduce cost, cross-docking is a way to cut transportation costs, another big cost area identified in the literature and second to picking labor.

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