BUSINESS INSIGHTS

A COLLEGE OF BUSINESS RESEARCH JOURNAL

Volume 10 Spring 2022

In This Issue

“This publication is designed to support and encourage excellence in undergraduate research and writing in all areas of business…”

NON-DISCRIMINATION/EQUAL OPPORTUNITY POLICY

Athens State University, as an equal opportunity/affirmative action institution, complies with all applicable federal and state laws regarding nondiscrimination and affirmative action. Athens State University does not discriminate on the basis of race, color, national origin, age, marital status, gender, gender identity, gender expression, pregnancy, sexual orientation, disability, religion, genetic information, or veteran status in employment, or admissions to or participation in educational programs and activities. Inquiries or concerns may be addressed to the Office of the Vice President for Financial Affairs, 300 N. Beaty St., Athens, AL 35611, 256-216-3303.

The College of Business at Athens State University is dedicated to providing students with the education and opportunities that will prepare them for professional positions in business, finance, or government by enhancing their skills in research, communication, technology, ethics, and critical thinking. The Athens State University College of Business Student Research Journal is now in its tenth year of publication and is designed to support and encourage excellence in undergraduate and graduate research and writing in all areas of business and to provide a vehicle for the dissemination of quality research studies by Athens State University students.

By contributing research papers to the Journal to be considered for publication, students and faculty have the opportunity to gain experience and expand their professional resumes with peer-reviewed, scholarly publications. Each issue of the journal is freely accessible on the College of Business website, making the articles available to students, researchers, employers, and others interested in the many topics our students pursue in their academic studies. We encourage Athens State University undergraduate and graduate students, and their faculty advisors, to review and submit outstanding research papers to the Journal for publication.

With the tenth issue of the Research Journal, we are continuing to expand the exceptional work done by Athens State University College of Business students and faculty as they pursue their educational journey and begin or continue their professional careers. We would like to invite you to join us in this venture.

Sincerely,

Charles R. Roberts
Editor-in-Chief

Submission and Format Guidelines:

Submission guidelines

- Papers must be written by students (either individual or groups) enrolled at the institution.
- Graduating students may submit papers up to 30 days after graduation.
- Each paper must have a faculty sponsor, who may be the course instructor, lead for the course, or a faculty member from the College of Business List of Sponsors.
- Papers must be original.
- Papers cannot have been previously published, nor be currently under consideration or accepted for publication in print or electronic form.
- Multiple submissions by a single author are accepted.
- All types of research-based papers are eligible for consideration.
- It is recommended that student authors consult the College of Business Writing Rubric for writing guidelines. Students are also encouraged to consult the Athens State University Writing Center for advice on any questions regarding APA format, grammar, etc.
- All papers must be checked through Safe Assign (or an equivalent anti-plagiarism program), with this check verified by the faculty sponsor, before submission.
- Student authors retain copyright privileges.
- All research involving human subjects must have received approval from the Institutional Review Board prior to being conducted.
- The author is responsible for guaranteeing that no material in the paper infringes on existing copyrights.
- Each paper must be submitted by a faculty sponsor and must be accompanied by a completed Faculty Sponsor Form.
- Papers must be submitted by email to Dr. Charles R. Roberts (Charles.Roberts@athens.edu).
- Include contact information including name, phone number, email address and mailing address of each student author.
- Papers will be reviewed by three reviewers using a double-blind process.
- Papers will be evaluated based on strength of the thesis, clarity of concepts, demonstrated knowledge, and quality of empirical/documentary research, use of relevant visuals, grammar, and format.
- Students and faculty sponsors will be contacted when each paper is received and again after the review process is complete.
- The faculty sponsor will be identified on the published paper, separately from the student author(s) and any co-authors.

Format guidelines

- Papers are limited to no more than 25 pages, not counting the title page, abstract page, and list of references.
- Papers must be typed, using 12 pt Times Roman, and double-spaced, with 1" margins on all sides, using Microsoft Word.
- Papers must conform to APA format.
- Each paper must include an abstract (150-250 words).
- All pages must be numbered and have a running head (shortened form of title).
- The title page must include the paper title, full name of each author with email address, phone number, and mailing address, and name of the faculty sponsor with contact information.
- Names of the author(s) and faculty advisor should appear ONLY on the title page.

Supply Chain Innovations that Foster Brick-and-Mortar Retailer Success: A Literature Review

Dr. Cynthia R. Lovelace, CSCP
Assistant Professor of Logistics

ABSTRACT

The local retailer has been struggling of late, for a variety of reasons. The consumer's appetite for "shopping from the couch" is taking away their opportunities to shop local, along with the livelihoods of their friends and neighbors who work there and, too often, the local tax dollars generated from those sales. Online sales are also impacting the environment, replacing single full truckload deliveries to local stores with many local parcel deliveries, as well as increasing product returns, each of which requires return shipping. Consumers will not choose local shopping experiences, American goods, or environmentally-friendly packaging if the choice requires more effort, less convenience, or inferior product choices. These options must compete for the consumer's business. For the local retailer, this means that they must compete on product selection, availability, and price, all the while building upon their competitive advantages of proximity to customer, concierge customer service, and touch-and-try shopping opportunities. Their ability to compete going forward will be aided by innovative supply chain and inventory management technologies, as well as forward-thinking changes in retail management strategy. This literature survey will demonstrate that there are strategies and technology innovations available to retailers that allow them to preserve the in-store shopping experience for their customers, make a profit while doing so, and contribute to local communities via their retail presence there. Opportunities for future research will be identified.

Introduction

The local retailer has been struggling of late, for a variety of reasons. Gone are the days when local shopping was an adventure, a time when the ability to touch, lift, smell, try on or try out potential purchases was considered crucial. Today's consumers have surrendered to the lure of clicking Buy and then waiting, not so patiently, for their order to magically arrive at their doorstep. And, because returning those items that didn't fit, smell right, or work as promised has been made even easier—free from their doorstep, just in reverse—they conveniently ignore the ramifications of these choices. A drive by any mall or strip retail center reveals an increasingly eerie quiet that is almost palpable. The bustle of the neighborhood department store is slowly being replaced by the sound of parcel trucks delivering, then quite often returning, these online purchases. The consumer's appetite for shopping-from-the-couch is taking away their opportunities to shop local, along with the livelihoods of their friends and neighbors who work there and (too often) the local tax dollars generated from those sales. Online sales are also impacting the environment, replacing single full truckload deliveries to local stores with many local parcel deliveries, as well as increasing product returns, each of which also requires return shipping. It may be time for America's consumers to rethink their shopping choices.

As recent history shows, pleas to "Buy American" or "Shop Local" have seen little business impact, so appeals to a sense of community have not significantly changed shopping habits. The same rationale applies, for example, to eco-friendly shopping bags. Consumers will not choose local shopping experiences, American goods, or environmentally-friendly bags if the choice requires more effort, less convenience, or inferior product choices. These options must compete for the consumer's business. For the local retailer, this means that they must compete on product selection, availability, and price, all the while building upon their competitive advantages of proximity to customer, concierge customer service, and touch-and-try shopping opportunities. Their ability to compete going forward will be aided by innovative supply chain and inventory management technologies, as well as forward-thinking changes in retail management strategy.

Background

E-commerce has experienced significant growth since 2014, with average year-over-year growth over 20% pre-COVID and 14.8% growth over the previous year at the end of 2020 ("Retail e-commerce sales," 2021; Coppola, 2021). This equated to 25.5% of total retail sales at the end of April 2020 (the beginning of COVID lockdowns), approximately 6% over recent e-commerce trends (Schnure, 2021). In 2020, when over two billion consumers embraced online shopping due to COVID quarantines and in-store shopping restrictions, worldwide e-retail sales plunged in Spring 2020 as the full effect of COVID restrictions and lockdowns were felt, with U.S. retail spending (adjusted for seasonality) falling 49.1% in March 2020 and another 75.3% in April of that same year (U.S. Census Bureau, 2020). However, consumers demonstrated their desire to resume in-store shopping as these restrictions were lifted, with e-commerce annual percentage change leveling off at approximately 7.75% at the end of 2021 (U.S. Census Bureau, 18 Nov 2021) and department stores showing a monthly adjusted increase in sales of 5% at the end of August 2021 (U.S. Census Bureau, 16 Nov 2021). This corresponded with a slight decrease in e-commerce to 22.7% of total retail sales in February 2021 (Schnure, 2021). Therefore, while increases in e-commerce have been significant, retail sales growth rates remain above the rate of inflation (Schnure, 2021). The National Retail Federation (NRF) predicted that overall retail sales would grow up to 13.5% to more than $4.44 trillion by the end of 2021, with non-store and online sales growing up to 23% or $1.13 trillion total. A study by Mood Media discovered that consumers spent approximately 11% more of both time and money in traditional brick-and-mortar stores in 2021 than they did in 2020, with 80% of global consumers saying that they feel comfortable or very comfortable return-

ing to in-store shopping (Moore, 2021).

To compete with e-commerce, traditional brick-and-mortar retailers have begun expanding their fulfillment options to include e-commerce, vendor order fulfillment, buy-online-pickup-in-store (BOPIS), curbside delivery, or some combination of these options, with the seamless integration of these options designed to increase the overall value proposition (Wallace et al, 2004). This expansion requires a higher level of supply chain and logistics management, since the supply chain is now broadened to include the consumer's home or order pickup point (Lang & Bressolles, 2013; Yao & Zhang, 2012). The increased logistical challenges include unpredictable demand, short delivery timeframes, and small order sizes characteristic of e-commerce (Campbell & Salvesbergh, 2006; Hsiao, 2009). Making omni-channel fulfillment profitable can be a challenge, and many retailers are now considering either selling off or separating their e-commerce business in order to boost earnings (Lombardo, 2021), which in some sense defeats the original purpose of omni-channel fulfillment in the eyes of the consumer. Traditional retailers must determine the proper balance between brick-and-mortar store fulfillment and e-commerce options that meet consumer needs while also maximizing the value proposition of the organization.

Consumers have demonstrated that they still value the in-store shopping experience, resulting in efforts by retailers to capitalize on their investments in brick-and-mortar outlets. In this paper, a literature review of the latest research in store fulfillment business strategies will be presented. This literature survey will demonstrate that there are strategies and technology innovations available to retailers that allow them to preserve the in-store shopping experience for their customers, make a profit while doing so, and contribute to local communities via their retail presence there. Opportunities for future research will also be identified.

Factors Affecting Consumer Order Fulfillment Choices

There are several factors that influence whether consumers purchase items online or shop in traditional retail stores. In the early days of e-commerce, Ranganatham and Ganapathy (2002), studied these factors and discovered that, at that time, both security and privacy issues made consumers hesitant to purchase items online. When choosing between omni-channel retailers, Gowar and Hoberg (2019) noted that price was the top decision criteria for consumers, followed by lead time and convenience. They, along with Hsiao (2009), developed monetary criteria for choosing online ordering over physical store shopping. For example, "the value of delivery time for a purchased book from an online bookstore to a consumer is approximately $0.53 per day, which means an online bookstore will have to lower a book's price by $0.53 to attract a physical bookstore shopper if the delivery is delayed for one day." The consumer's perception of convenience may shift when multiple fulfillment options are offered, which can result in fulfillment channel shifts (Gallino & Moreno, 2014). In-store shopping is also chosen for reasons other than the purchase of goods, reasons which may be difficult to define. This in-person experience also offers entertainment, opportunities for social interaction and physical movement, and trip chaining (Mokhtarian, 2004). Consumer behavior must be understood to design an omni-channel fulfillment that is both efficient and effective (Ehmke & Campbell, 2014).

Fulfillment channel choice may also vary by market segments. Marcucci et al. (2021) determined that product price and service cost are the primary decision factors within the e-grocery retail segment. Brick-and-mortar retailers who adopt BOPIS grocery order fulfillment have built upon their existing logistics structure to fulfill these orders, but additional factors must be accounted for. These include where and when to split pallet loads of product into individual product units. Omni-channel fulfillment integration for the grocery sector also significantly depends on the individual product, market, and retailer (Wollenburg et al, 2018). In the fast fashion market segment, Yang and Zhang (2020) found that traditional retail stores that implement ship-to-store (STS) fulfillment with a quick response (QR) strategy may see profits reduced, since inventory availability information may lead consumers away from traditional stores, and potential cross-selling opportunities, to online order placement. Other market segments face similar fulfillment issues, depending upon the characteristics of the products sold and their associated patterns of demand.

Brick-and-Mortar Store Fulfillment Strategies

A number of researchers have evaluated the feasibility of filling online orders with in-store inventory as part of an omni-channel fulfillment strategy. Buy-online-pickup-in-store (BOPIS), or store fulfillment, allows retailers to increase inventory availability for online orders while increasing place utility of existing store inventory. Successfully implementing this strategy requires collaboration in both demand management and order fulfillment (Ishfaq & Raja, 2018). The choice between online fulfillment by a fulfillment center or with in-store inventory depends upon many factors. Difrancesco et al (2021) determined the optimal policy configuration for omni-channel store fulfillment in terms of the number of packers, number of pickers, and pick cut-off time. They found that the trade-off between customer service level and fulfillment costs is critical. Schneider and Klabjan (2013) investigated different inventory control policies for omni-channel retailers in order to determine optimal base stock and (s, S) inventory policies. Difrancesco and Huchzermeier (2020) determined that the refund rate, the values of the return rate, and online order appeal defined the conditions under which a Nash equilibrium exists between competing omni-channel retailers, assuming online order returns (with a restocking fee) but no brick-and-mortar returns. Many retailers elect to utilize a two-channel online fulfillment strategy, whereby online orders are filled either by fulfillment center or with in-store inventory. Zhao et al (2015) modeled this dual-channel supply chain with lateral inventory transshipment allowed to determine the optimal inventory order levels and transshipment price that maximized total profit. Store fulfillment offers a feasible option for omni-channel fulfillment if optimal inventory policies are followed.

One negative consequence of using store fulfillment as part of an overall omni-channel fulfillment strategy is the inventory competition that is created between the order fulfillment nodes. Geng and Mallik (2007) utilized a game theoretic model to model inventory stocking decisions between a manufacturer's direct channel and its independent retailer for the same product. They found that an equilibrium condition exists whereby the manufacturer may short a retailer's order even when production capacity exists to fill the order in full to grow total supply chain profit. The choice of fulfillment option is also impacted by shipment consolidation opportunities and the resultant decrease in shipping costs via economies of scale (Torabi et al, 2015). Their mixed-integer programming model was developed to assist retailers in optimizing order fill percentage while minimizing total logistics costs. Therefore, utilizing brick-and-mortar store inventory for online order fulfillment, as part of an omni-channel fulfillment strategy, offers opportunities to maintain existing retail sites for traditional shopping while also offering omni-channel fulfillment to customers, but inventory balancing and logistics optimization present challenges to this approach.

Enabling Technologies for Brick-and-Mortar Retailers

New technologies are available to help traditional retailers compete with their online counterparts. Consumers value the user reviews, comparison pricing, and abundant inventory associated with online shopping, so brick-and-mortar stores must consider the adoption of the technologies that provide these options to their customers as well. A 2015 study by the Boston Consulting Group showed that brick-and-mortar retailers who adopt digital technologies in their stores tend to outperform their non-digital store retailer competitors (Burggraaff et al, 2015). The authors of the BCG study define digital implementation leaders as those that have "fully integrated digital technologies into their daily activities, pursued a multichannel strategy, developed a data analytics capability, and integrated digital into the in-store experience" (Burggraaff et al, 2015). These digital solutions have workflow management, merchandising, and ground-level sales floor management capabilities, as well as an information architecture that provides detailed analysis of customer transactions. Smart Retailing, which incorporates technology-enabled personalization (TEP) into the consumer shopping experience, is quickly being adopted by traditional retailers, who spent approximately $203.6 billion on retail IT in 2019 (Tech, 2019).

Unfortunately, small local retailers may be priced out of smart retailing technologies or have no need of it given their size. In this case, collaborations with order fulfillment specialists may provide opportunities for e-commerce business expansion. E-commerce order fulfillment involves inventory receiving, warehousing, order processing, shipping, and returns processing. These tasks can be completed in-house via self-fulfillment, outsourced to a third party logistics provider (3PL), completed via drop shipment (which removes the retailer from manufacturing and order fulfillment), and hybrid fulfillment (a custom combination of the other options). The choice between these options depends upon order volume, location, and technology such as inventory management or warehouse management software (Nicasio, 2021). According to Simmons (2021), the top fulfillment companies for small businesses are ShipBob (best overall order fulfillment), ShipMonk (best for customer service and warehouse automation), Red Stag Fulfillment (best for special handling needs including oversized, heavy, and high-value goods), FedEx (best combined freight and fulfillment services), FBA (Fulfilled by Amazon—best for Amazon sellers), and Whitebox (best combined marketplace management service). These services support small retailers by offering affordable outsourcing options for online order fulfillment.

As small retailers expand their business with the addition of e-commerce, other financial challenges may arise. Capital shortage is of particular concern as potential markets expand and sales increase (Jing et al., 2012). Because intermediaries are reduced in the shortened e-commerce supply chain, the financial burdens of small- to medium-sized enterprises (SMEs) are increased. Logistics finance has emerged as a new financing alternative for small enterprises that may encounter difficulties in acquiring capital from traditional financial institutions, and blockchain-enabled logistics finance can facilitate the implementation of logistics finance for capital-constrained small businesses (Li et al., 2020).

Marketing Strategies for Small Retailers

For small brick-and-mortar retailers who wish to expand into e-commerce, marketing their wares to a broader potential customer base is critical. Technology-focused marketing activities offer the opportunity to reach more customers and increase sales. Social media outlets are crucial to small retailers, since they reach billions of customers worldwide and provide opportunities to grow the business, communicate the offerings of their business, and interact with customers with minimal financial investment (Gumus & Kutahyali, 2017). As of 2019, 45% of the world's population (3.5 billion) used social media regularly, including 72% of U.S. adults (Social Media Fact Sheet, 2019). Social media analytics programs, such as Facebook Insights, are available to provide descriptive and/or predictive analytics for various key performance indicators (KPIs) such as demographic data about viewers and how many people respond to posts. This information is valuable to small retailers but should be combined with information on a business' internal and external environment, including factors such as consumers' social values, when developing a marketing strategy. The choice of KPI is influenced by a retailer's marketing goals, which may include awareness, engagement, or conversion/retention (Kim, 2021). For optimal social media marketing effectiveness, small businesses should identify what they want to accomplish with social media marketing. Gholston et al. (2016) suggest that retailers focus their social media pages on starting interactions with potential customers, creating and building relationships (as opposed to building sales), and increasing exposure to their brands. Social media platforms serve as invaluable, affordable marketing resources for the small retailer.

Environmental Impact Comparisons: Brick-and-Mortar vs. e-Commerce

Arguably, the most distinguishing factor between brick-and-mortar retailing and online order fulfillment is environmental impact. Some authors take the position that traditional store retail shopping is more environmentally friendly than e-commerce. A 2019 study by Deloitte and Simon revealed that retail shopping within shopping malls was up to 60% more environmentally sustainable than shopping online. Brick-and-mortar shopping allows for trip chaining, or the incorporation of multiple trip segments or stops between trip anchor points (home to home, work to work, home to school, etc.) so that multiple purchases can be made from multiple stores during one trip (Primerano et al., 2008). Thus, trip chaining while brick-and-mortar shopping, a common occurrence, is associated with more purchases per trip and a greater number of errands per trip, thus reducing the amount of emissions per item purchased (Deloitte & Simon, 2019). Environmental impacts are further reduced when all shopping stops occur within a single mall location. E-commerce, on the other hand, is associated with increased returns and additional shipping packaging, which negatively impact the environment (Mohan, 2020).

Other authors take the opposing view. Jaller (2021) stated that shopping exclusively online is approximately 87% more efficient in terms of CO^2 emissions and total vehicle miles traveled when compared to shopping in-store only. When comparing the greenhouse gas (GHG) footprints of product distribution and purchase between traditional shopping and bricks-and-clicks store fulfillment (click and fulfillment via physical store delivery), Shamohammadi et al. (2020) determined that bricks-and-clicks shopping likely has the lower GHG footprint of the two, with variability in the GHG footprints strongly influenced by the last-mile travel distance and the number of items purchased. Furthermore, the environmental impact of both shopping options can be reduced by changing the delivery mode to more eco-friendly options, such as electric vehicles or shared (public) transport. Other environmentally friendly fulfillment strategies include load consolidation, full parcel truckloads, and offerings of slower shipping to facilitate these strategies (Martinez, 2020). Also, the consumer can choose to complete their full purchase at one outlet, either brick-and-mortar or online, rather than spreading purchases over multi-

ple outlets, which increase the number of vehicles on the road (Heffernan, 2021).

Opportunities for Future Research

The review of the extant literature on brick-and-mortar retailing revealed little comparative research of brick-and-mortar vs. online retailing that included assessments of the qualitative social, sensory, or community impacts on consumer shopping choices. Future research utilizing simulation models to compare these shopping channels that incorporate these variables, along with order cycle time and total logistics cost, is forthcoming from the author.

Conclusion

Traditional brick-and-mortar retail shopping is the lifeblood of community life, providing local tax dollars, local employment, opportunities to touch and try before you buy, social outing opportunities, and the building of a sense of community. E-commerce, on the other hand, provides a level of convenience and inventory visibility undreamt of only a few short years ago. Consumers are therefore faced with an impossible civic and financial choice, with e-commerce winning the battle as of late. In some sense, the consumer has sold his community's soul to e-commerce, leading to the demise of many local retailers and an increase in total delivery miles traveled and shipment packaging, along with the associated environmental costs.

Perhaps there is a middle ground, where traditional local community brick-and-mortar shopping can be preserved while also taking advantage of the options available through e-commerce. Local retailers, especially small retailers, must take advantage of enabling technologies that broaden their market beyond the local community and foster omni-channel fulfillment (Burggraaff et al., 2015). E-tailers, on the other hand, must be cognizant of environmental impact and overall supply chain efficiency when developing logistics strategies. By building an omni-channel fulfillment strategy that incorporates the many benefits of brick-and-mortar shopping within the value proposition, retailers can ensure their future success.

REFERENCES

Burggraff, P., Schuuring, M., & Urda, B. (2015). Four digital enablers: Bringing technology into the retail store. *White Paper, Boston Consulting Group.*

Campbell, A.M., & Savelsbergh, M.W.P. (2006). Incentive schemes for attended home delivery services. *Transportation Science, 40*(3), 327-341.

Coppola, D. (2021, October 27). E-commerce worldwide—statistics and facts. *Statista.* **https://www.statista.com/topics/871/online-shopping/#dossierKeyfigures**

Deloitte and Simon (2019, December 19). New study reveals in-store shopping is up to 60 percent more favorable for the environment than online shopping. White paper. **https://investors.simon.com/node/23866/pdf**

Difrancesco, R.M., & Huchzermeier, A. (2020). Multichannel retail competition with product returns: Effects of restocking fee legislation. *Electronic Commerce Research and Applications, 43,* 100993.

Difrancesco, R.M., van Schilt, I.M., & Winkenbach, M. (2021). Optimal in-store fulfillment policies for online orders in an omni-channel retail environment. *European Journal of Operational Research, 293*(3), 1058-1076.

Ehmke, J.F., & Campbell, A.M. (2014). Customer acceptance mechanisms for home deliveries in metropolitan areas. *European Journal of Operational Research, 233* (1), 193-207.

Gallino, S., & Moreno, A. (2014). Integration of online and offline channels in retail: The impact of sharing reliable inventory availability information. *Management Science, 60*(6), 1434-1451.

Gholston, K., Kuofie, M., & Hakin, A. (2016). Social media for marketing by small business. *Journal of Marketing and Management, 7*(1), 24-39.

Gowar, T., & Hoberg, K. (2019). Customers' valuation of time and convenience in e-fulfillment. *International Journal of Physical Distribution and Logistics Management, 49*(1), 75-98.

Gumus, N., & Kutahyali, D. (2017). Perceptions of social media by small and medium enterprises. *International Journal of Business and Information, 12*(2), 123-148.

Heffernan, T. (2021, April 22). How to shop online more sustainably. *Wirecutter Blog, New York Times.* **https://www.nytimes.com/wirecutter/blog/shop-online-sustainably/**

Hsiao, M.H. (2009). Shopping mode choice: Physical store shopping versus e-shopping. *Transportation Research Part 3: Logistics and Transportation Review, 45*(1), 86-95.

Ishfaq, R., & Raja, U. (2018). Evaluation of order fulfillment options in retail supply chains. *Decision Sciences, 49* (3), 487-521.

Jaller, M., Associate Professor and Co-Director, Sustainable Freight Research Center, University of California Davis, phone interview with T. Heffernan, March 10, 2021, as cited in Heffernan (2021).

Jing, B., Chen, X., & Cai, G. (2012). Equilibrium financing in a distribution channel with capital constraint. *Production Operations Management, 21*(6)*,* 1090-1101.

Kim, S. (2021). Mapping social media analytics for small business: A case study of business analytics. *International Journal of Fashion Design, Technology and Education, 14*(2), 218-231.

Lang, G., & Bressoles, G. (2013). Economic performance and customer expectation in e-fulfillment systems: A multi -channel retailer perspective. *Supply Chain Forum: An International Journal, 14*(1) 16-26.

Li, M., Shao, S., Ye, Q., Xu, G., & Huang, G. (2020). Blockchain-enabled logistics finance execution platform for capital-constrained e-commerce retail. *Robotics and Computer-Integrated Manufacturing, 65,* October 2020, 101962.

Lombardo, C. (2021, December 6). Activist urges Kohl's to weight separating e-commerce unit. *The Wall Street Journal*, B3.

Marcucci, E., Gatta, V., LePira, M., Chao, T., & Li, S. (2021). Bricks or clicks? Consumer channel choice and its transport and environmental implications for the grocery market in Norway. *Cities, 110*(2021), 103046.

Martinez, J.V., Director, Sustainable Logistics Initiative, Massachusetts Institute of Technology, phone interview with T. Heffernan, March 16, 2020, as cited in Heffernan (2021).

Mohan, A.M. (2020, March 9). In-store vs. online shopping: Which is more eco-friendly? *Packaging World.* **https://www.packworld.com/issues/sustainability/article/21119800/instore-vs-online-shopping-which-is-more-ecofriendly**

Mokhtarian, P.L. (2004). A conceptual analysis of the transportation impacts of B2C e-commerce. *Transportation, 31,* 257-284.

Moore, S. (2021, June). 2021 shopper sentiments study. *Mood Media.* **https://us.moodmedia.com/wp-content/uploads/2021/06/2021-Shopper-Sentiments.pdf**

Nicasio, F. (2021, October 11). Understanding the order fulfillment process: An essential guide for small businesses. *Noissue.* **https://noissue.co/blog/understanding-order-fulfillment-for-small-businesses/**

Primerano, F., Taylor, M.A.P., Pitaksringkarn, L., & Tisato, P. (2008). Defining and understanding trip chaining behavior. *Transportation, 35*(1), 55-72.

Ranganathan, C., & Ganapathy, S. (2002). Key dimension of business-to-consumer websites. *Information and Management, 39*(6), 457-465.

Schneider, F., & Klabjan, D. (2013). Inventory control in multichannel retail. *European Journal of Operational Research, 227*(1), 101-111.

Schnure, C. (2021, March 18). Brick-and-mortar retailing is bouncing back. *Forbes.* **https://www.forbes.com/sites/calvinschnure/2021/03/18/brick-and-mortar-retail-is-bouncing-back/?sh=7d501cf9d0f4**

Shamohammadi, S., Steinmann, Z.J.N., Tanbjerg, L., van Loon, P., King, J.M.H., & Huijbregts, M.A.J. (2020). Comparative greenhouse gas footprinting of online versus traditional shopping for fast-moving consumer goods: A stochastic approach. *Environmental Science Technology, 54*(6), 3499-3509.

Simmons, K.J. (2021, July 22). Six best order fulfillment services for small businesses in 2021. *Fit Small Business.* **https://fitsmallbusiness.com/order-fulfillment-services/**

Social Media Fact Sheet. (2019, June 19). Pew Research Center. **https://www.pewresearch.org/internet/fact-sheet/social-media/**

Retail e-commerce sales worldwide from 2014-2024. (2021). Statista. **https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/**

Tech. (2019). A world in motion: Retail digital transformation across the globe, and the technology supporting it. *Retail Week,* World Retail Congress. **https://www.tech-festival.com/tech-catalysts**

Torabi, S.A., Hassini, E., & Jeihoonian, M. (2015). Fulfillment source allocation, inventory transshipment, and customer order transfer in e-tailing. *Transportation Research Part E: Logistics and Transportation Review, 79*(July 2015), 128-144. Full access: **https://isiarticles.com/bundles/Article/pre/pdf/41104.pdf**

U.S. Census Bureau. (2020, May 15). *Advance monthly retail trade report*. **https://www.census.gov/retail/index.html**

U.S. Census Bureau. (2021, November 18). *Quarter retail e-commerce sales report, 3rd quarter 2021.* **https://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf**

U.S. Census Bureau. (2021, November 16). *September 2021 monthly retail trade and food services report.* **https://www.census.gov/retail/index.html**

Wallace, D.W., Giese, J.L., & Johnson, J.L. (2004). Customer retailer loyalty in the context of multiple channel strategies. *Journal of Retailing, 80*(4), 249-263.

Wollenburg, J., Hubner, A., Kunn, H., & Trautrims, A. (2018). From bricks-and-mortar to bricks-and-clicks: Logistics networks in omni-channel grocery retailing. *International Journal of Physical Distribution and Logistics Management, 48*(4), 415-438.

Yang, D., & Zhang, X. (2020). Quick response and omnichannel retail operations with the ship-to-store program. *International Transactions in Operational Research, 27*(6), 3007-3030.

Yao, Y., & Zhang, J. (2012). Pricing for shipping services of online retailers: Analytical and empirical approaches. *Decision Support Systems, 53*(2), 368-380.

Zhao, F., Wu, D., Liang, L., & Dolgui, A. (2015). Lateral inventory transshipment problem in online-to-offline supply chain. *International Journal of Production Research, 54*(7), 1951-1963. **https://www.tandfonline.com/doi/full/10.1080/00207543.2015.1070971**

Supply Chain/Logistics Innovations during the COVID-19 Crisis

Dominique Clerge
M.S. Global Logistics and Supply Chain Management (Management Track)

ABSTRACT

The COVID-19 pandemic has upended the global logistics system, with not a single industry spared from its impact. From raw material to consumer, every echelon of the world's supply chains have been affected, necessitating the revamp of Standard Operating Procedures (SOP) to mitigate the impact of this pandemic. Therefore, companies are prioritizing supply chain resilience by using technological innovations such as artificial intelligence (AI), data analytics, blockchain, new communication platforms, e-Commerce, robotics, and contactless technologies. This paper will describe the impacts of COVID-19 on the world's supply chains and identify the capabilities and competencies needed for businesses to adjust and thrive during these abnormal days. The information gathered for this research is comprised of early quantitative and qualitative data related to the impact, resulting innovations, and implemented operating adjustments associated with supply chains operating during the COVID-19 pandemic. The findings of this paper show that innovation capabilities used during the pandemic may have changed the logistics field beyond the pandemic and created a new normal for the supply chain of the future.

Introduction

The global supply chain shock that started in China during the fall of 2019 with the beginning of the SARS-COVID-19 pandemic has had a direct impact on the dynamic between supply and demand. In particular, the COVID-19 pandemic has exposed the vulnerabilities of the global logistical network, starting with sourcing and continuing through production and on to the final consumer. The effects have varied with the type and location of product produced, but they have been felt by almost every single firm and at every echelon in the world's supply chains. Among the impacts were labor shortages, supply and component shortages, and logistically bottlenecked supply chains. The pandemic reshaped the standard of operation of most businesses by forcing them to increase their resiliency without weakening their competitiveness. Though most of the mitigation strategies and technologies covered here existed before the pandemic, COVID-19 exponentially accelerated the use of e-Commerce and robotics as part of an innovative operational adjustment strategy. This paper presents an overview of all major supply chains innovations resulting from the COVID-19 pandemic and their impacts on logistics strategies and readiness.

COVID-19 Impacts on Global Supply Chains

The pandemic has impacted every aspect of business operations, with manpower being the most affected factor in logistics operations. Some companies have shuttered business operations in factories because of government restrictions and a sharp increase in demand for basic supplies. Government restrictions and safety precautions are forcing firms to reduce staff or switch to remove work, prompting the need for access to technological advancements for online staff meetings. Using data from a recent Deloitte survey (Castañeda-Navarrete, et al., 2021), over a thousand respondents from various business sectors operating in China expressed concern about the impact of the pandemic on staffing to serve customers, as well as sales volume and cash flow. In manufacturing plants, employee safety is a major concern that resulted in switching to remote working or staff shortage. A shortage in lumber production has created a housing market bubble with an average inflation of $30,000 for each new house built (Fedirko et al., 2021). Overall, a significant reduction in staffing to mitigate the risk of COVID-19 exposure has resulted in a sharp drop in productivity. Labor shortage reamins a persistent challenge as the pandemic continues.

For almost two years of the COVID-19 pandemic, the manufacturing supply chain has yet to recover to a relatively normal mode of operation. Presently, raw material and component supply shortage is one of the major problems affecting global production operations. Manufacturers had to halt or slow down production in early 2020 to rethink their safety protocols and to implement government guidance. A shift in necessary supplies versus regular supplies has amplified the supply shortage globally. Before the pandemic, firms were dealing with nationalist politics between the U.S. and China which resulted in global inflation amidst a trade war, but not a drop in production; with the pandemic, global production has dropped 10.5%, a decline that may take years to reverse (Fedirko et al., 2021). The COVID-19 pandemic had forced manufacturers to slow, suspend operations, or innovate to stay afloat. According to the U.S. Federal Reserve, industrial production fell 13.7% with almost a complete halt in motor vehicles and parts production. Other sectors such as mining and food production fell by 0.9% and 5.0% respectively (Fedirko et al., 2021). The drop in global production creates a supply gap against the demand curve which grew steadily because of economic stimulus measures.

Disruptions created by the pandemic have led to global disruptions and shortages for certain goods. The manufacturing sector has found ways to mitigate certain risks, with firms adopting anticipatory initiatives such as overproduction due to demand uncertainties. However, overproduction for certain supply categories in anticipation of future demand creates a bottleneck situation at ports of entry (Siagian et al., 2021). Global trade rebounded strongly after the slump created by the initial pandemic shockwave. The rebound in production for global trade has contributed to issues such as shortages of shipping containers, overcrowded warehouses, long lead times, bottlenecks at ports of entry, and a more urgent need for trucking and addition-

al transportation services (Gutsuliak, 2021). The freight transport bottleneck situation, and resulting increase in freight rates, threatens the global supply chain and obligates firms to increase their prices for all goods. This global logistics constraint is contributing to high inflation at a rate not seen during the last 30 years (Suneja, 2020). The COVID-19 pandemic is having a trickle-down effect on every metric of the global economy, including production and freight transportation.

Business Operation Adjustment

Supply chain recovery does not mean a return to pre-pandemic normalcy. As the global economy gets back on track, companies must ensure reliable production to feed the supply chain and to anticipate any increase in demand. Workplace safety is the number one concern for all businesses. For that reason, new standard operating procedures in compliance with local government guidance or regulations must be in place. In many firms, workers who are back to work are required to be vaccinated against the virus or be subject to regular COVID-19 testing. One of the new initiatives of COVID workplace safety operation is the use of thermometers at business entry to detect signs of COVID-19 symptoms such as fever (OSHA, 2022). Periodic sanitization of machines, tools, and shared workspaces is the new norm, but poses a challenge in term of production speed. Businesses will not be able to return to the pre-pandemic operating procedures any time soon and must adopt a modified approach to doing business, including the acceptance of new supply or distribution networks developed during the pandemic. New technologies and innovative business models may be used going forward to succeed in business while reducing supply chain risk due to COVID-19.

e-Commerce Expansion

One approach to mitigating pandemic business risk is the embrace of omni-channel fulfillment. In particular, the global pandemic has accelerated the demand for e-commerce. This global trend exposes consumers to a large variety of products in the comfort of their home with curbside pickup or fast shipping services available. Since 2020, Amazon's U.S. share of e-commerce grew by almost 6% from 39-45%, a modest increase based on the size of U.S. sales (Pouye, 2021). One of the new shifts in business strategy involves the integration of online shopping to maintain sales volume while reducing the need for in-store purchases, a strategy that provides global relief against COVID-19 exposure fears. New or reluctant companies embraced e-commerce, which saw a 300% boom over the last 18 months (Pouye, 2021). To comply with self-imposed social distancing regulations, major retailers such as Walmart and Target adopted a new way to reduce the risk of COVID-19 exposure by integrating curbside pickup. Although Buy Online Pickup In Store (BOPIS) is not new, the addition of curbside pickup was a new concept developed during the pandemic and widely accepted by all customers (Sarkis, 2020).

Teleconference Technology Innovation

The COVID-19 pandemic also created the need for remote work to mitigate the risk of viral exposure. Businesses were in dire need of a technological solution suited for teleworking in the form of a better digital tool capable of supporting videoconference meetings, both within their own organization and with supply chain partners. Many software developers have tried to enter the lucrative field of videoconferencing at a large scale, but only a few are considered top tier providers: Zoom, Microsoft (MS) Teams, and Cisco WebEx. MS Teams and Zoom are currently the most popular videoconference service providers. Recent research from the firm IDC found that more than 55% of digital technology developers intend to invest more in videoconferencing technology to meet the growing market of social-distancing meeting (Siagian et al., 2021). The unlimited participants in the cloud video calling, voice call, chatting, and file sharing features are a by-product of COVID-19 pandemic response initiatives. These new teleconference technologies have a direct impact on information sharing throughout the supply chain channels.

Contactless Technology

The need for socially distanced business transactions during COVID-19 also renewed interest in contactless technologies. Contactless technologies are a game changer for the transportation, retail, and entertainment sectors. A major innovation in the transportation sector is the introduction of electronic Bill of Lading called eBOL. The eBOL increases visibility, provides entry-error reduction, and protects the drivers by helping them avoid unnecessary contact with customers (NASDAQ OMX, 2020). This transportation industry technology also helps carriers become more resilient and efficient. Other touchless passenger features have also been adopted for their daily air travel customers.

Contactless technology is also being embraced by the retail sector. Shopping experience is becoming more contactless at all major traditional supermarkets such as Whole Food Market, Target, or Walmart. The latter has been using self-service kiosks for its thousands of daily customers. Amazon has a similar concept called Just Walk Out technology available at one of the major U.S. airports. Walmart has integrated the curbside service into their daily operations since the start of the pandemic. Though this service was originally exclusive to elderly customers, it is now available to all customers (Siagian et al., 2021).

Robotics and Artificial Intelligence (AI)

Autonomous vehicles and artificial intelligence (AI) are two technologies that existed years before the pandemic but are now replacing human workers at a faster rate since the pandemic and are becoming an integral part of business operations. Autonomous vehicles are becoming the widely used mechanism at warehouse and point of sales. Since e-commerce is driving sales growth for retailers, autonomous vehicles such as the Amazon Robots are improving speed and accuracy for all routine order pick operations within Amazon's warehouses. In some warehouses, these robots outnumber people (Alam et al., 2021). With the introduction of AI in warehouse operations, e-commerce connects robotics to AI with speed and precision never seen before the pandemic to improve firms' competitiveness (Xu & Huang, 2021). Robotic parcel sorting is also booming in most warehouses to mitigate the manpower shortage and reduce supply chain waste. Most major supply chains are integrating AI and robotics in their supply chain process as the new normal during and after the pandemic. Since Amazon is the uncontested leader of e-commerce, their logistics innovation requires massive spending in AI technologies and robotics such as automated storage and retrieval autonomous vehicles.

Conclusion

The COVID-19 pandemic created a need for drastic changes in the world's supply chain. Businesses had to adjust in order to follow government safety COVID regulations and implement

new business strategies to avoid supply disruptions. These adjustments came in the form of safety measures, technological innovations, and omni-channel order fulfillment. In the long term, the pandemic has forced supply chains to take more holistic approaches to the types of innovations that will solve their supply and logistics constraints and mitigate their risks. The impact of the pandemic will be felt years after its ending. Therefore, the collective logistics goal remains the same: supply chains must overcome their COVID-19 crisis impacts by making their supply chain more resilient and adapting it to the new normal through technological innovation. One thing is clear; customers may continue to have their product preferences, but new supply or distribution networks developed during the pandemic may become the new standard operating procedures.

REFERENCES

Alam, A., Katib, I., Albeshri, A., & Mehmood, R. (2021). iResponse: An AI and IoT-enabled framework for autonomous COVID-19 pandemic management. *Sustainability (Basel, Switzerland), 13*(7), 3797. **https://doi.org/10.3390/su13073797**

Castañeda-Navarrete, J., Hauge, J., & López-Gómez, C. (2021). COVID-19's impacts on global value chains as seen in the apparel industry. *Development Policy Review, 39*(6), 953-970. **https://doi.org/10.1111/dpr.12539**

Da Xu, Y.G., & Huang, M. (2021). Can artificial intelligence improve firms' competitiveness during the Covid-19 pandemic: International evidence. *Emerging Markets Finance & Trade, 57*(10), 2812-2825. **https://doi.org/10.1080/1540496X2021.1899911**

Fedirko, O., Zatonatska, T., Wolowiec, T., & Skowron, S. (2021). Data science and marketing in e-commerce amid Covid-19 pandemic. *European Research Studies, 24*(S2), 3-16.

Gutsuliak, V.N. (2021). Impact of Covid-19 on the freedom of the merchant ship's access to foreign ports. *Pomorstvo (Rijeka: 1999), 35*(1), 23-29. **https://doi.org/10.31217/p.35.1.3**

NASDAQ OMX. (2020). North America contactless biometrics technology market 2020-2026—Covid-19 pandemic pushing everyone to minimize physical contact with common surfaces. *NASDAQ OMX's News Release Distribution Channel.*

Occupational Safety and Health Administration (OSHA). (2022). Protecting workers: Guidance on mitigating and preventing the spread of Covid-19 in the workplace. **https://www.osha.gov/coronavirus/safework**

Pouye, M.B. (2021). The covid-19 impact on digital & e-commerce. *Journal of Economics Bibliography, 8*(2), 82-96. **https://doi.org/10.1453/jeb.v8i2.2204**

Sarkis, J. (2020). Supply chain sustainability: Learning from the Covid-19 pandemic. *International Journal of Operations & Production Management, 41*(1), 63-73. **https://doi.org/10.1108/IJOPM-08-2020-0568**

Siagian, H., Tarigan, Z., & Jie, H. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in Covid-19 era. *Sustainability (Basel, Switzerland), 13*(9), 4669. **https://doi.org/10.3390/su13094669**

Suneja, K. (2020, April 22). Covid-19 impact: Port congestion adds to exporters' woes [Shipping-Transport]. *The Economic Times,* Industry.

The Impact of Cyberattacks on Businesses

Bobby R. Morris
B.S. Management with Minor in Healthcare Management Major

ABSTRACT

A cyberattack is any effort to gain an illegal entry into a business's computer, server, or any part of the network without permission and with the intent to cause damage to the business. Some of these cyberattack strategies are relatively low risk, yet can deliver enormous paybacks for hackers. However, a cyberattack can inflict higher financial costs, reputational damage, and even legal consequences on the business. This paper explores some of these impacts in greater detail.

Introduction

Cyberattacks are low-risk and can deliver enormous paybacks for hackers. The attacks are ruthless and impact millions of people every year. A cyberattack is an effort to gain an illegal entry into a business's computer, server, or any part of the network without their permission with the intent to cause damage. A cyberattack's purpose is to disrupt, disable, or destroy the business's computer systems or to modify, block, or take the data held inside their systems (Pratt, 2021). Furthermore, cyberattacks can be launched from anywhere in the world by anyone using one or more various strategies. "In 2015, 58% of corporate computers had at least one attempted malware attack blocked, up 3% from 2014, according to Kaspersky Lab's Security Bulletin 2015" (Cyberattacks on business rising, 2016, p. 1). Although some of these cyberattack strategies are found to be profitable for hackers who commit these crimes, they can have a huge impact on the business, such as higher financial costs, reputational damage, and even legal consequences.

Higher Financial Cost

Global Economy

The world's largest and most successful companies operate in the global economy. Therefore, when they suffer a cyberattack, the global market will be affected. "In a recent FBI computer crime and security survey, 85 percent of respondents revealed that they had detected security breaches within the last twelve months" (Lichtenbaum & Schneck, 2002, p. 40). However, while the businesses work to fight off cyberattacks by increasing cybersecurity, they also burden the internet and other networks by increasing the cost of doing commerce. In other words, cyberattacks enact a secondary cost on electronic communications and transactions, as new security processes drive up the cost of doing business and challenge important values such as privacy.

Cost to Businesses

All U.S. citizens should assume that all of the data used as their identifiable information has been compromised at one point or another and is being used for heinous activities. Cybercrime costs contain a number of elements, including damage and destruction of data files, stealing of intellectual assets, and embezzling money. "Sixty-four percent of respondents acknowledged financial losses due to computer breaches, and the 35 percent (186 respondents) that quantified their losses reported $377,828,700 in financial losses" (Lichtenbaum & Schneck, 2002, p. 40). These numbers represent only a small portion of the affected businesses each year.

Evolving Business for Hackers

Cyber threats have evolved from pursuing and harming computers, networks, and smartphones, to such things as automobiles, railway systems, power grids, and anything else connected to a network in some fashion. This transformation has further complicated cybersecurity. Cybercriminals realize they can hold businesses, and our economy, captive through these breaches, ransomware attacks, and denial of service attacks. These entities are joining forces, and their likelihood of detection and prosecution is estimated to be as low as 0.05 percent in the U.S. (Kramer, 2020). These cyberattacks are costing U.S. businesses millions of dollars every year.

Reputational Damage

Customer Relationships

Trust is an essential element of customer relationships (*Cybersecurity News,* 2019). The reputational damage that can hit a business when a cyberattack has occurred can have a major impact on that business's future. While some large businesses may be able to incur the loss of some of their customers, for small to medium businesses, reputational damage and loss of customers can have devastating effects. Poor reputation is also related to increased recruitment and retention costs, which reduces operating profits and hinders higher returns.

Technology

No matter how sophisticated the technology may be, it is not *if* a cyberattack will occur, but *when.* Fighting the increase of cybercrime means disrupting a business model that uses easy-to-use applications to produce high profits with low risk (Gaidosch, 2018). These applications are used to steal someone's username and passwords, sell the information to other parties, and also breach other valuable customer data. When this attack happens and data is damaged, the business may have to devote hours reestablishing and fixing the damage, as well as reassuring their stockholders that the incident will not happen again. If a business becomes a victim to numerous occurrences of cybercrime, it can hurt the company's public reputation and discourage customers from seeking additional services from that company. It also may make investors lose confidence in where they are placing their money.

Loyalty

After an attack happens, there is plenty of blame to go around. Most companies will need to rebuild brand loyalty after a breach ("Data breaches cost more than money," 2016). Unfor-

tunately, the blame and reputational damage usually fall on the shoulders of the company and not the hackers. When individual data has been stolen, or at the very least compromised, customers feel let down. Company privacy policies may not be read, but customers believe that any company that collects their individual data has a responsibility to protect it (*Cybersecurity News,* 2019). It is very difficult to obtain new customers for future business growth after the reputational damage of a cyberattack has occurred. Customers see a data breach as a breach of the business's obligation to keep their data private and secure, and many will seek out alternative companies for those services in the future.

Legal Consequences

Security Practices

Consumers are spending more and more time online and have instant access to more content than ever before (Lanois, 2016). Due to the rapid growth of digital devices and social networks, more and more data is being generated on a daily basis. With this, even by using the maximum cybersecurity practices possible, data breaches and cyberattacks are increasing year by year. Whether it is financial assets, private assets, or intellectual assets, data theft is a constant danger for everyone (Shaw, 2021). It is crucial to ensure that the information collected and obtained is properly safeguarded for everyone's protection.

Security and Privacy Laws

In today's society where more and more businesses are turning to a digital format, in some countries, data is more valuable than gold or oil. Data security and privacy laws require a business to manage the security of the data they hold. If this data is compromised and they fail to take appropriate security measures, businesses may face fines and regulatory penalties (Lanois, 2016). Since the internet is highly dynamic, cyberattack protocols are being developed and widely distributed among enterprises around the world. Businesses must adopt such security protocols as keeping software up to date, using a password manager, and providing education for their employees on the procedures to reduce the risks of cyberattacks that may occur in the future.

Legal Penalties

All businesses need to know the legal penalties of a data breach and how to navigate solutions that are available to them. These solutions will allow them to protect themselves from the consequences of a cyberattack when it happens. If the business deals with customer data that has been collected and stored, then it must show that it has implemented practical measures in the business to ensure data safety. The laws and penalties for data security vary from one country to another. In the U.S., there are no federal privacy laws in place yet. Businesses located here must obey all state-specific laws.

Reporting Method

Businesses must inform individuals and the authorities about a data breach. Even though the business and the customers may be aware of the risks involved in cyberattacks, legal action may still be brought against the business if it fails to do so. The likelihood and severity of the fines will vary according to the level of the breach, the number of individuals affected, and the area of jurisdiction. If the organization or system encounters a cyberattack that leads to a data breach, they have a legal obligation to notify the affected individuals as soon as possible. Since it is all about consumer data protection and privacy, the business should notify regulators like the Securities and Exchange Commission (SEC), the Federal Trade Commission (FTC), the Consumer Financial Protection Bureau, and the Federal Communications Commission (FCC) to ensure timely disclosure of the cyberattack (Shaw, 2021).

Conclusion

Cyberattacks and cybersecurity breaches seem unavoidable, so businesses also need to focus on how fast they identify breaches, how efficiently they respond, and how soon they get processes back on track for normal operations (Gaidosch, 2018). The more time it takes to recover from a cyberattack, the greater the impact on the business in areas such as higher financial cost, reputational damage, and legal consequences. Although large businesses may have teams of employees dedicated to controlling cybersecurity, for many small businesses, they may be using somebody who likely has many other responsibilities in the organization and may be caught up in those responsibilities, not spending enough time on the subject of cyberattacks. To defend against the rising range of cyber threats, businesses can rely on technology to supply security, scan for threats, secure the system network, and perform threat analyses on the network. Luckily, the technology security background is full of these types of solutions designed to help businesses approach security more reasonably. The economy of a city, state, or the entire nation could potentially be immobilized by a cyberattack. It is very important to have strategies in place to protect the business and its customers from this constantly evolving cybersecurity industry.

REFERENCES

Cyberattacks on business rising. (2016). *Information Management, 50*(2), 12.

Cybersecurity News. (2019, January 25). *New research reveals extent of reputation loss after a cyberattack.* Web Titan. **https://www.spamtitan.com/web-filtering/new-research-reveals-extent-of-reputation-loss-after-a-cyberattack/**

Data breaches cost more than money. (2016). *Information Management, 50*(6), 7.

Gaidosch, T. (2018). The industrialization of cybercrime: Finance and development. *Finance & Development, 55* (2), 22-25.

Kramer, J. (2020, November 18). *Cybercrime to cost the world $10.5 trillion annually by 2025.* GlobeNewswire News Room. **https://www.globenewswire.com/newes-release/2020/11/18/2129432/0/en/Cybercrime-To-Cost-The-World-10-5-Trillion-Annually-By-2025.html**

Lanois, P. (2016). Data protection in Singapore: What have we learned? *Journal of Internet Law, 20*(2), 1-16.

Lichtenbaum, P., & Schneck, M. (2002). The response to cyberattacks: Balancing security and cost. *International Lawyer, 36,* 39-48.

Pratt, M.K. (2021, January 13). *The ultimate guide to cybersecurity planning for businesses.* Techtarget. **https://searchsecurity.techtarget.com/definition/cyber-**

attack

Shaw, R. (2021, January 25). *A look at the legal consequence of a cyber attack.* The State of Security. **https://www.tripwire.com/state-of-security/featured/legal-consequence-cyber-attack/**

COVID-19 Effects on the Medical Supply Chain

David L. Gatlin
M.S. Global Logistics and Supply Chain Management Major

ABSTRACT

The current supply chain model for the medical industry is a stale approach that has been in use for several decades. While there were some improvements to it prior to the SARS COVID-19 pandemic of 2020, it took this catastrophic event for medical supply chain suppliers to reevaluate where they manufacture their products and how quickly they can react to emergencies. In 2020, the United States came to a sudden halt when faced with an adversary like it had never seen before. It almost imploded as a nation, a situation that could have been avoided by proper supply chain risk assessment and mitigation. This paper will describe key characteristics of the U.S. medical supply chain before the pandemic, the problems encountered during the pandemic, some of the solutions implemented in response to the crisis, and steps that should be taken in the future to increase supply chain resilience. These steps would help prevent the same kind of shutdown that happened in 2020.

Introduction

Medicines for ailments such as headaches, sore throat, back pain, or the common cold are so readily available in the United States that the ordinary citizen does not stop to consider how they are made or how they arrive on the shelves of the local retailer. It is similar to the little boy or girl that is asked where milk comes from and replies "the grocery store." The supply chains that serve the medical industry are just as important, in fact more so, than those companies that supply hair spray, walking shoes, and food for our tables. Without a dependable, resilient system for producing and distributing medical supplies, seriously ill people could possibly die. Manufacturing companies have looked at various supply chain models for years trying to develop the most cost-effective way to manufacture and distribute their products. While the producers of cars, building supplies, and other everyday essential items have worked diligently to improve the way they do business, the medical industry has only recently begun to assess its supply networks to determine how it can do things better. The SARS COVID-19 pandemic of 2020 was a rude awakening to those in the medical industry tasked with providing critical supplies where and when needed.

Key Elements of the U.S. Medical Supply Chain

As the new millennium dawned, the world's manufacturers and their supporting cast embraced the concept of supply chain management like never before. Organizations began to adopt the concepts of lean manufacturing developed decades prior to increase productivity and lower costs. Those who did it well succeeded, and those that did not are now either struggling to survive or out of business. In contrast, the healthcare industry has been slow to embrace these supply chain management strategies, and research regarding supply chain management in the healthcare industry is weak in comparison to the manufacturing sector. In the March 2021 issue of *Benchmarking: An International Journal,* Senna et al. (2021) stated that "Healthcare supply chains are a unique segment, since their main objective is to save lives instead of [boosting] profit." That statement may be true; but if healthcare companies are going to continue to operate, they do have to make a profit. Otherwise, they have no way to expand and improve their capabilities. Organizations throughout the medical supply chain must reduce their costs and improve their ability to deliver in order to stay competitive. Doctors may be able to retain patients based on their expertise and good bedside manner, but hospitals, pharmaceutical companies, and medical supply companies—key components of the healthcare supply chain—must make a profit to stay in business.

Problems Encountered during the Pandemic

A critical issue for the healthcare industry is lead time. A study published in the *Journal of Manufacturing Technology Management* shows that while members of the medical supply chain try to reduce costs by using lean manufacturing practices, they must hold high inventories due to the long lead times (Nag et al., 2014). Critical equipment can take months to produce, and if a change needs to be made, it can take years. On average, vaccines normally take 3 to 5 years of testing before they are approved for distribution. Only the nature of the COVID-19 crisis in 2020 and the government's emergency use authorization allowed a COVID-19 vaccine to be released in a much shorter time frame. Another problem encountered during the pandemic was that many medical supplies were made in a Just-in-Time fashion, so there may not be adequate inventory to meet emergency needs everywhere. It was also revealed to the public that a majority of the personal protective equipment (PPE) used by medical personnel, such as face masks, were manufactured in Asia. When production of these items began in the U.S., we also found that many of the raw products that are used to produce PPE were also made overseas where labor costs are lower. With most countries shut down due to the pandemic, the needed raw materials were not available. Lean manufacturing is a good way to reduce costs and can still be used effectively during a normal emergency; but in a worldwide event such as a pandemic, it does not work. More research can be expected on this topic in the future. The chaos that happened in 2020 due to the COVID-19 pandemic cannot be allowed to happen again.

The COVID-19 pandemic will inevitably change the way the medical field is looked upon regarding emergency response capability. Lapide (2020) stated that he always assumed the United States had met the basic needs of its citizens (food, shelter, water, medical supplies, and security) and was on the path upward to an enlightened society as shown in Maslow's Hierarchy of Needs. It was not until the pandemic occurred that he realized the country still has a long way to go. At the beginning of the pandemic, basic supplies such as food and water disappeared from store shelves. Rubbing alcohol and what we consider everyday type medicines were suddenly unavailable. Lapide has theorized that the shortages in PPE were due to the Pareto-based ABC inventory management practices that may have been in place at many companies (Lapide, 2020). The type of worldwide events that occurred in 2020 do not happen every year, but a response plan needs to

be put in place to prevent the shortages of such common items as toilet paper. Most hospitals and urgent care facilities were not ready for the onslaught of patients received once the COVID-19 virus started spreading. Others, such as the Mayo Clinic, were prepared for the emergency, at least in a small way. In his article "COVID-19: Implications for Supply Chain Management," Francis (2020) quoted another article that said, "Proactive action based on monitoring improves a supply chain's agility and resilience in the face of uncertainty" (as cited in Francis, 2020). Uncertainty is something every supply chain tries to mitigate.

Potential Solutions

Supply Chain Improvements

Inevitably, uncertainty happens: something breaks down; an airplane crashes; a ship gets sideways in a canal and loses some of its load; tornadoes tear through a state, shutting down power to an entire county. The only certainty is that someday the uncertain will happen. In his article, Francis (2020) talks about new software that is powered by advanced analytics to run the supply chain demands of Mayo hospitals served in a five-state area. The supply chain staff provided various metrics to predict PPE burn rates compared to on-hand inventory, and the software yielded days of inventory based on patient mix. This allowed the Mayo Clinic to quickly gauge their ability to meet the needs of patients and caregivers.

Manufacturers are looking at ways to pull some of the essential supplies production out of Asia and locate them either in Mexico or in other parts of the United States to reduce supply risk. Some in the supply chain industry believe that companies have so regionalized manufacturing that the shortages suffered due to the complete shutdown of the country in 2020 should have been predictable. Every state did not shut down at the same time. The larger states, such as New York and California, where most of the regional manufacturing takes place, shut down first. This led to shortages in vital supplies to the rest of the country. If new, decentralized facilities are built around the country in areas that need jobs, the risk of shortages around the country would be minimized if a second wave of COVID or similar type of emergency occurs (Zhu et al., 2020).

Improved Technologies

Another advance that showed promise even before the pandemic is 3-D printing. A story in the *MIT Sloan Management Review* tells of a hospital in Brescia, Italy, that was running out of ventilator valves. The hospital could not get the valves from its normal supplier, so it turned to a local company with a 3-D printer. The company reverse-engineered the valve and created a prototype. Once it was determined that it worked, the company produced hundreds of them for the hospital (Cutcher-Gershenfeld et al., 2021). It is possible that 3-D printing can produce many other parts needed by hospitals. However, 3-D printing is not the only new risk-mitigating technology available. Another is an emerging manufacturing resource called fab labs. They are computer-controlled machines that can cut out various items such as knives, tools, and even furniture. Cutcher-Gershenfeld et al. (2021) state that the number of these new fab labs is over 2,000 worldwide. Since they use common software, someone in one part of the world can develop something a person in another part of the world can build using the same design. With the exciting possibilities of this emerging technology also comes the fear that this technology could be used to produce things such as weapons. It is something that needs to be watched carefully.

Collaboration

To further mitigate healthcare supply chain risk, more collaboration is needed. A 2018 paper published in *Journal of Advances in Management Research* talks about the need for a comprehensive review of the healthcare supply chain environments (Mathur et al., 2018). This particular paper is focused mainly on India, but the findings presented there hold true for the healthcare supply chain worldwide. When the world realized the pandemic was a global event, countries with available resources, such as the United States, Great Britain, and Italy, were able to divert available manufacturing resources from their intended purpose to make needed medical supplies. Breweries began making sanitizer. Other companies began making PPE such as face masks and face shields. Some companies may have manufactured a new line of products it did not realize it could make. The manufacturing upswing in companies that were allowed to work was similar to the increased production seen during World War II. One of the complications mentioned in the *TQM Journal* in January 2021, was that there does not seem to be an industry-wide standard for PPE. Gowns produced in Turkey for hospitals in the United Kingdom (UK) did not meet UK standards and caused further delays in getting supplies for those treating serious patients (Leite et al., 2021). Grieco (2020) suggests there needs to be a committee or a partnership formed to analyze domestic and international supply chain gaps and identify potential upgrades for strategically important products. This would not eliminate disruptions of service during a global event, but it would limit the amount of disruption. Collaboration is the key to making everything work.

Steps to Increase Supply Chain Resilience

Many ideas have surfaced regarding how to prevent supply chain disruptions in future pandemic-type situations. The first requirement is commitment. Healthcare providers and their suppliers must show a commitment to improve the way that vital resources are procured and distributed throughout their supply chain network. Increased collaboration is needed between healthcare providers, distributors, and manufacturers to determine what supplies are needed, when they are needed, where they should be placed, and how inventory visibility will be increased throughout the supply chain. The most obvious solution would be to establish a digital network between the supply chain partners. A good example would be the Mayo Clinic supply chain approach mentioned previously. First, the Mayo Clinic plan included a list of key contacts from the local Health and Human Services office to Federal Emergency Management Agency and the Centers for Disease Control (Francis, 2020). Second, companies must be willing to spend funds to improve the communication network throughout the entire medical supply chain. Third, they need to develop a culture of trust among their suppliers. In an article in *Benchmarking: An International Journal,* it was pointed out that trust depends on the willingness of the parties involved in the experience (Abdullah et al., 2017). A company must be able to trust that the information given to its suppliers will not be used against them or forwarded on to their competitors. Fourth, global standards must be put in place so, no matter where PPE, medicine,

sanitizer, or any other item is made, it all meets the same standard and is acceptable to all nations. Finally, there should be a strategic reserve of medical supplies. During the energy crisis of the late 1970s and early 1980s, the U.S. Government developed a strategic oil reserve. Developing such a reserve for medical supplies would be a tremendous advantage for hospitals. This may prove to be challenging since many medical supplies have an expiration date and would need to be replenished on a regular basis. As seen in the Mayo Clinic example, investment in inventory management software, along with constant dialogue with suppliers and distributors, is essential to having a robust supply chain network.

A plan needs to be put in place and a working group established to oversee the overhaul of medical supply chains. This is not the sort of plan that needs to be controlled by the government, but the government has to have a voice. The priority should be the protection of the medical personnel and first responders. They should be the first recipients of any new vaccines developed to fight pandemic-type viruses. If the medical personnel die, who will take care of everyone else who gets sick? Next, basic care facilities such as nursing homes and other long-term facilities should be evaluated. The one place that most people would have considered to be the easiest to control the spread of COVID-19 became the most feared place to live. Konetzka reported that 40% of all COVID-19 deaths in the United States have been linked to long-term care facilities (Konetzka, 2021). The close living quarters and the ability of people to spread the virus asymptomatically caused these facilities to become "death pits," as described by *The New York Times* in an April 2020 article (Konetzka, 2020). Special care and preference in vaccinations should be given to these residents due to their age and vulnerability to disease. Finally, the plan needs the financial support of the private sector. Some people are of the opinion that the government should manage and pay for this initiative; but past experience shows that when the government takes control of a problem, it often makes it worse. Plus, government expenditures for such an initiative may result in higher taxes for its citizens.

Conclusion

This paper has only begun to scratch the surface of the problems facing the healthcare supply chains. As seen in the Mayo Clinic example, investment in inventory management software, along with constant dialogue with suppliers and distributors, is essential to having a robust supply chain network. The need for robotics improvement was not mentioned here, but robotics and artificial intelligence are emerging technologies that will help this industry. The technology is still being improved. If more robotic-type equipment enhanced with artificial intelligent software was readily available, there would be no need to put as many healthcare workers in harm's way when a pandemic type of virus such as Ebola or COVID-19 is present. As was seen in the story from Italy, 3-D printing offers promising results for quick supplies. If every hospital had a 3-D printer available to make its own heart valves, face shields, or whatever else the industry finds it can make, the time to get those items would be greatly reduced. It has been said over the years that necessity is the mother of invention. The medical industry has a need to improve its supply chains. The ability to make these improvements does not rest solely on those currently working in the industry, but they need to lead the initiative to make change happen.

REFERENCES

Abdullah, A.B., Abdullah, M.I., & Saleh, F.I.M. (2017). The effects of trust with suppliers on hospital supply chain performance. *Benchmarking: An International Journal, 24*(3), 694-715.

Cutcher-Gershenfeld, J., Gershenfeld, A., & Gershenfeld, N. (2021). The promise of self-sufficient production. *MIT Sloan Management Review, 62*(2), 66-72.

Francis, J.R. (2020). COVID-19: Implications for supply chain management. *Frontiers of Health Services Management, 37*(1).

Grieco, W. (2020). Rethinking domestic supply chains. *Chemical Engineering Progress, 116*(8), 22.

Konetzka, R.T. (2021). Improving the fate of nursing homes during the COVID-19 pandemic: The need for policy. *American Journal of Public Health, 111*(4), 632-634.

Lapide, L. (2020). Supply chain heroes and lessons from COVID-19. *Supply Chain Management Review, 24* (5), 4-6.

Leite, H., Lindsay, C., & Kumar, M. (2021). COVID-19 outbreak: Implications on healthcare operations. *The TQM Journal, 33*(1), 247-256.

Mathur, B., Gupta, S., Meena, M., & Dangayach, G.S. (2018). Healthcare supply chain management: Literature review and some issues. *Journal of Advances in Management Research, 15*(3), 265-287.

Nag, B., Han, C., Yao, D.Q. (2014). Mapping supply chain strategy: An industry analysis. *Journal of Manufacturing Technology Management, 25*(3), 351-370.

Senna, P., Reis, A., Dias, C., & Coelho, O. (2021). A systematic literature review on supply chain risk management: Is healthcare management a forsaken research field? *Benchmarking: An International Journal, 28*(3), 926-956.

Zhu, G., Chou, M., & Tsai, C. (2020). Lessons learned from the COVID-19 pandemic exposing the shortcomings of current supply chain operations: A long-term prescriptive offering. *Sustainability, 12.* **https://doi-org.athens.idm.oclc.org/10.3390/su12145858**

April 2011 Super Outbreak—A Risk Assessment

Jeannia Terry
B.S. Management of Technology with Minor in Accounting Major

ABSTRACT

April 27, 2011, was the date of a major tornado outbreak that affected numerous communities in the state of Alabama, as well as other states in the same region. Three of the tornadoes were EF-5, the highest and strongest rating on the Enhances Fujita (EF) scale. Tuscaloosa, Alabama was the hardest hit area in the state, numbering 230 fatalities and 2,200 injured. This paper examines the devastation of the tornado outbreak and provides the results of the risk analysis that was conducted following the event. Based on the analysis results, recommendations are offered that can potentially mitigate the risks should a similar event occur in the future.

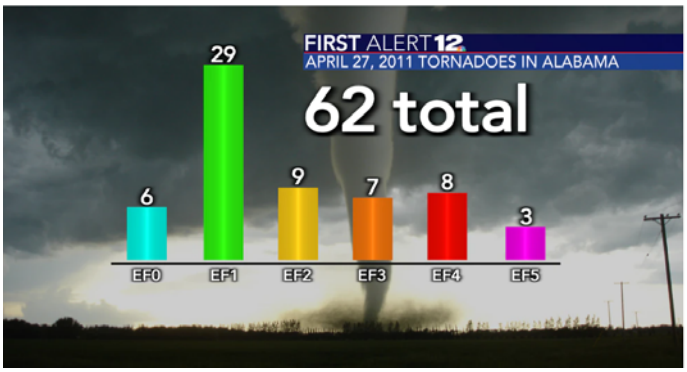

Figure 1—A Summary of Alabama Tornadoes during April 2011

The Disaster

April 27, 2011, will forever be marked as a day never forgotten by Alabama residents who lived through it. The Tornado Outbreak lasted four days and had an impact in at least 26 states and included approximately 62 tornadoes in our state (see Figure 1). The Outbreak happened in three rounds. The first round was in the northern part of the state. The second round moved to the Tennessee Valley area which includes Huntsville and Decatur. The third and final round in Alabama continued across the state and included the following areas: Tuscaloosa-Birmingham (EF4), Cullman (EF4), Lake Martin (EF4), St Clair County to Cherokee County (EF4), Dekalb County (EF5), a long track from Hackleburg to Phil Campbell (EF5), and the long track from Pickens County to Marshall County (EF4). This day created a record-breaking number of tornadoes. There were numerous communities in the state affected by this outbreak. The wind speeds were incomprehensible to the human mind and wielded utter destruction (see Figure 2). There was a total of 348 fatalities that occurred across multiple states with the most (253) in Alabama.

History

Alabama is considered a tornado alley because of its location. In addition to location, Alabama tornadoes historically have a much larger and longer path to expand upon, which ultimately allows tornadoes to do more damage. This makes Alabama and other surrounding states more susceptible to tornadic activity. The state of Alabama has been experiencing devastating tornadoes since 1884, when an event known as the "Enigma Tornado Outbreak" occurred. During this outbreak, an unknown number of tornadoes occurred during a 24-hour period. While the precise number of tornadoes and fatalities is unknown, the death toll was variously estimated to range from

Figure 2—Historic Tornado Devastation in Alabama

370-2,000 at the time (April 15, 2022). The second worst outbreak in a 24-hour period is the 1974 Super Outbreak. There were 148 confirmed tornadoes in the United States with 30 F4/F5 confirmed tornadoes (April 15, 2022). The third worst outbreak is the April 2011 Super Outbreak. This last outbreak was one of the deadliest tornadic activities in recorded history.

A tornado is defined as a rotating column of air touching the ground and is usually attached to the base of a thunderstorm. Most tornadoes are on the ground for less than 15 minutes. Tornadoes develop from severe thunderstorms in warm, moist, unstable air along and ahead of cold fronts. These types of thunderstorms also may generate large hail and damaging winds. A cloud of debris can help determine the location of the tornado, although the funnel may not be visible. Most tornadoes have wind speeds less than 110 miles per hour (180 km/h), are about 250 feet (80 m) across, and travel a few miles (several kilometers) before dissipating (April 20, 2022).

Tornadoes are rated on an Enhances Fujita (EF) Scale that is zero to five (see Table I). The EF scale became operational in 2007 and uses wind speeds and relative damage to rate a tornado. Several of the storms that occurred in April 2011, were EF5 tornadoes, the worst rating. The counties that were affected in Alabama were Bibb, Calhoun, Cullman, Dekalb, Elmore, Fayette, Franklin, Hale, Jackson, Jefferson, Lawrence,

SCALE	WIND ESTIMATE *** (MPH)	TYPICAL DAMAGE
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.

Table I—Tornado 'EF Scale'

Limestone, Madison, Marion, Marshall, St. Clair, Tallapoosa, Tuscaloosa, and Walker. These counties also suffered shocking and detrimental fatalities in many communities.

According to *Britannica*, Tuscaloosa was hit the hardest (see Figure 3) with 230 fatalities and 2,200 injured. There were multiple tornadoes that ripped through the city, and one large tornado with a diameter measuring nearly 1 mile (1.6 km) and wind speeds of approximately 200 miles (320 km) per hour passed through heavily populated residential areas. The local hospitals were overloaded with patients with tornado-related injuries, most being head/chest trauma and injuries involving limbs.

Figure 3—Historic Tornado Devastation in Alabama

Risk Analysis

After the storm, risk analyses were conducted to see what population was most at risk from these deadly tornadoes of April 2011. The analyses were conducted by male, female, location, warnings, and behavior parameters. The tornadoes were well documented for these risk factors. Known risk factors included: residing in a mobile home, a vehicle, or outdoors; being older than 60 years; not seeking shelter at all; and being unfamiliar with warning terminology (2013). Most of the population were indoors and in single-family homes and/or mobile homes when the calamity occurred. Most of the population that died succumbed on the scene where the event took place. Members of the rural population were three times more likely to die than those who were in an urban area. Data show that females were 40% more likely to die in comparison to the male counterparts. In addition, when examined by race, the white population's risk was double in comparison to the black population. The foremost cause of death during the tornado was being struck by a foreign object, cut by debris, and/or thrown by the severe winds. Victims' location during the tornadoes varied. Most were indoors in basements, bathrooms, underground shelters, bedrooms, and hallways. Lastly, warning response and behavior played a role in the likelihood of survival. Most of the fatalities did receive some form of warning. Many received warnings from others who heard warning sirens. However, **only 27.5% took action** that can be considered preventive measures. Another 86% took action only after hearing a warning or the approaching storm. Those remaining, for whatever reasons, took no action at all.

The recommendation that can be given based on this analysis is: emergency preparedness is essential to the populations' tornado survivability. Recommended improvements would include:

1. Easier access to shelters for the aging population;
2. More accessibility to weather radios; and
3. Additional warning sirens in designated locations, especially in rural areas.

If these measure will be taken, there should be measurably fewer fatalities and/or injuries in future tornado outbreaks. One thing can be determined to be a 100% probability (certainty) - Alabama will see more tornado outbreaks in the future. It is not an "if," but rather a "when."

The communities that were touched by this horrific Super Outbreak will never be the same. Hopefully, from this experience, the population in the stricken areas will incorporate and/or improve their emergency preparedness planning to include additional warning sirens and designated shelters, as well as providing special assistance to the aging population. April 2011 will forever remain in history as one of the worst

Super Tornado Outbreaks the state of Alabama has ever experienced. Making improvements to emergency preparedness will be the best way to prevent future loss of life and honor those who perished during this horrific day.

REFERENCES

Chiu, C.H., Schnall, A.H., Mertzlufft, C.E., Noe, R.S., Wolkin, A.F., Spears, J., Casey-Lockyer, M., & Vagi, S.J. (2013, August). Mortality from a tornado outbreak, Alabama, April 27, 2011. *American Journal of Public Health, 103*(8), e52-e58. **https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4007884/**

Encyclopaedia Britannica, Inc. (2011, May). *Super outbreak of 2011.* **https://www.britannica.com/event/Super-Outbreak-of-2011**

Sebree, T. (n.d.) *April 27, 2011: The unprecedented tornado outbreak.* WSFA12 News. **https://www.wsfa/2021/04/27/april-unprecedented-tornado-outbreak/**

Wikimedia Foundation. (2022, April 15). *Enigma tornado outbreak.* Wikipedia. **https://en.wikipedia.org/wiki/Enigma_tornado_outbreak**

Wikimedia Foundation. (2022, April 20). *Tornado.* Wikipedia. **https://en.wikipedia.org/wiki/Tornado**

The Significance of Workplace Diversity and Inclusion

Payton M. (Andrews) Roberts
B.S. Behavioral Science with Minors in Human Development and Business Administration Major

ABSTRACT

If one were to think about major influences and defining characteristics that are included in life, place of work would probably be near the top of that list. One of the most common questions asked when getting to know someone is "What do you do for a living?" Indeed, many people define who they are by where they work. And people spend a huge part of their week and everyday life at their place of work. Unfortunately, there are too many people who struggle with going to work. Maybe it is the actual work itself, or maybe it is something much deeper, such as problems with diversity and inclusion. One could love the work they do, but hate the company, employer, or overall atmosphere of their place of work. This research paper will attempt to understand what exactly is workplace diversity and inclusion, the importance of diversity and inclusion, and how to achieve such things. Thus, this paper will highlight the significance that understanding, recognizing, and implementing diversity and inclusion plays in the workplace.

Definitions of Diversity and Inclusion

In order to better understand this topic, we must understand exactly what diversity and inclusion in the workforce is. Farndale et al. (2015) attempt to give specific definitions and examples of diversity and inclusion. Their general definition of diversity and inclusion comes from Roberson (2006) who states "definitions of diversity focused primarily on heterogeneity and the demographic composition of groups or organizations, whereas definitions of inclusion focused on employee involvement and the integration of diversity into organizational systems and processes" (as cited in Farndale et al., 2015, pp. 677 -678). Further, Farndale et al. (2015) explain that in order to understand and obtain a more specific definition of diversity and inclusion, it is important to look into the context-specific aspects of diversity and inclusion. To do this, the authors studied diversity and inclusion in individual countries to understand how diversity and inclusion in the workforce differs among different cultures. The authors found that definitions of diversity and inclusion do indeed differ from country to country (Farndale et al., 2015). Therefore, when attempting to understand diversity and inclusion, it is vital to research the context-specific aspects of a given culture in order to get a better understanding of how diversity and inclusion is perceived for that specific culture.

Importance of Diversity and Inclusion in the Workplace

Next, we need to understand the importance of workplace diversity and inclusion. Every person, whether or not they want to admit it, has a desire to be included and accepted for who they are. When a person feels uninvolved or unaccepted, feelings of resentment and/or negativity can surface. In the workplace, if a person feels unwanted or unaccepted, the surfaced feelings of resentment and negativity can result in a decrease of work efficiency, group collaboration, and the overall effectiveness of the work output. Thus, it is absolutely imperative that diversity and inclusion is included in the workplace. Downey et al. (2015) implemented a study to discover the importance of workplace diversity and inclusion. In their study, they took 4,597 healthcare sector employees and asked them to complete an online diversity climate assessment. In the end, they found that diversity and inclusion practices in the workplace work to incorporate positive employee engagement and trust (Downey et al., 2015). Thomas and Ely (1996) state that "implementing diversity practices can result in positive outcomes for organizations such as increased profitability, creativity, flexibility, successful adjustment to fluctuations in the market, and overall individual and organizational growth" (as cited by Downey et al., 2015, p. 34). Thus, workplace diversity and inclusion not only helps the individual feel accepted, but it also helps the workplace be more efficient.

Diversity and inclusion can also help the workplace be more efficient by offering a wide variety of thoughts and ideas. Goldberg et al. (2019) looked into the topic of workplace diversity and inclusion with an attempt to understand the importance of it. They state that "diversity can lead to a more vigorous exchange of ideas that improves group decision making and performance and promotes innovation and creative problem solving" (Goldberg et al., 2019, p. 52). What this means is that when you have a mix of different people, whether it be those of a different race, gender, or culture, this allows for a mix of thoughts and ideas that would not have come as a result of multiple similar others. Here, we can conclude that workplace diversity and inclusion is extremely important for the well-being of a person, positive engagement and trust towards the company and team, and for the purpose of collaborative thought and innovative problem solving.

How to Implement Workplace Diversity and Inclusion

Now that we have a better understanding of what diversity and inclusion is and why it is important in the workforce, we need to understand how diversity and inclusion can be implemented. Since diversity is on the rise in the U.S., and because we have established the importance of diversity and inclusion, it is important to understand what practices should be put into place. Brimhall et al. (2017) focused on leader-member exchange in their study of workplace inclusion. Their theory was that when leaders treated followers as important members of the team, then followers would treat fellow followers with respect and dignity. The conclusion of their study confirmed that, indeed, this theory was true. High quality relationships between leaders and followers resulted in a higher work commitment and feeling of inclusion from the followers. This is one way to implement inclusion in the workforce.

As for diversity, this one may seem a bit trickier; as one cannot

force a group of diversified individuals to work together and/or for a company. While companies know and understand that diversity is increasing, little research and implementation have been utilized to increase work diversity. Hays-Thomas et al. (2012) worked together to understand different practices to increase work diversity. Among their research, they found that an effective tool for workplace diversity is diversity training. This training is implemented to help employees (and employers) learn how to work in a diverse environment. There are multiple types of training, all focusing on different aspects. Some of the notable aspects taught in this training include how to listen and interpret the words of culturally different others, how to communicate among sexes, and how to interact with diverse others. Hays-Thomas et al. (2012), though, argue that diversity training is not enough. They state that employers should be more specific with their training and include specific skill sets and traits that will help the employees to work well in their specific field and with diverse others. In other words, diversity training should be more specific to individual companies and industries.

To add to the topic of implementation of diversity and inclusion, Goldberg et al. (2019) encourages businesses to implement a "diversity plan." In this plan, employers should define diversity and goals, assess their current diversity process, engage managers in solving problems, expose managers to different groups of people, encourage change, communicate, and measure employee satisfaction. The authors add that companies should "work with diverse individuals, encourage them to be open about their personal opinions, and educate employees about differences that they may encounter" (Goldberg et al., 2019, p. 56). The main theme that Goldberg and others conclude is the importance of employee training. If employees are not trained to be well diversified and understand how to appropriately approach diverse others, then diversity will lack in the workspace. Further, if employees are not modeled inclusiveness by those higher than them, then inclusion will also lack in the workplace. To conclude this third major point, it is clear that work diversity and inclusion must be taught. If companies want to thrive, then employee training on diversity and inclusion should be implemented. Also, those in different positions should treat others with respect and dignity, and honor them as an included team member.

Conclusion

Throughout this paper, we have learned that, in order to understand a specific definition of diversity and inclusion, one must look at the context-specifics of the given circumstance. We concluded that diversity and inclusion is a very important aspect to employee satisfaction, workplace efficiency, mental health, and overall effectiveness of a given company. Finally, we understand how to implement such measures to include diversity and inclusion in the workplace. This can be done through training and building team relationships. It is clear to see that as diversity is growing in America, so should we see more diversity in the workforce. Not only should we see more diversity, but with that, implementations should be made to be sure that inclusiveness is taking part in every company. If a business truly wants to succeed, then measures must be taken to ensure that their company is a place of diversity and inclusion.

REFERENCES

Brimhall, K.C., Mor Barak, M.E., Hurlburt, M., McArdle, J.J., Palinkas, L., & Henwood, B. (2017). Increasing workplace inclusion: The promise of leader-member exchange. *Human Service Organizations: Management, Leadership & Governance, 41*(3), 222-239. **doi:10.1080/23303131.2016.1251522**

Downey, S.N., Werff, L., Thomas, K.M., & Plaut, V.C. (2015). The role of diversity practices and inclusion in promoting trust and employee engagement. *Journal of Applied Social Psychology, 45*(1), 35-44. **https://doi-org.athens.idm.oclc.org/10.1111/jasp.12273**

Farndale E., Biron, M., Briscoe, D.R., & Raghuram, S. (2015). A global perspective on diversity and inclusion in work organizations. *International Journal of Human Resource Management, 26*(6), 677-687. **doi:10.1080/09585192.2014.991511**

Goldberg, S.R., Kessler, L.L., & Govern, M. (2019). Fostering diversity and inclusion in the accounting workplace. *CPA Journal, 89*(12), 50-57.

Hays-Thomas, R., Bowen, A., & Boudreaux, M. (2012). Skills for diversity and inclusion in organizations: A review and preliminary investigation. *The Psychologist Manager Journal, 15*(2), 128-141.

EQ's Contribution to Teamwork, Job Satisfaction, Leadership, and Profitability in the Workforce

Joy Oettel
BSED Technical Education Major

ABSTRACT

In the past few decades, the value of understanding and developing emotional intelligence (EI), often used interchangeably with emotional quotient (EQ), in the workforce has become clearer to the business world and is now a highly sought-after employee characteristic. Since the 1990s, numerous studies on the effects of EI in the workforce have been conducted. This paper will explore the significance, history, and growing research related to emotional intelligence and explain the components of EQ and the advantages a high EQ brings to teamwork, conflict resolution, job satisfaction, commitment, leadership, and profitability.

Introduction

Is it better to be "book smart" or "people smart"? A growing body of evidence and employers say the latter. Being "people smart" means having high emotional intelligence. Emotional intelligence or EQ is the ability to use the awareness of one's own emotions as well as the emotions of others to form lasting, cooperative relationships (Akers & Porter, 2003). EQ is also sometimes referred to as EI, for emotional intelligence, and the two terms are often used interchangeably. In the past few decades, the value of understanding and developing emotional intelligence in the workforce has become clearer to the business world, and it is now a sought-after employee characteristic. This is because EQ offers significant benefits to the workforce including stronger teamwork, job satisfaction, leadership, and greater profitability.

Significance of EQ

EQ vs IQ

Society has long associated IQ or Intelligence Quotient with success. However, having a high IQ does not guarantee career achievement, because EI or EQ is also a critical factor. In fact, "psychologists generally agree that among the ingredients for success, IQ counts for roughly 10% (at best 25%); the rest depends on everything else—including EQ" (Akers & Porter, 2003, p. 67). One study of Harvard graduates in business, law, medicine, and teaching showed "little or no correlation between IQ indicators (such as entrance exam scores) and subsequent career success" (Akers & Porter, 2003, p. 66). Social scientists and employers now look to EI as a significant factor in career success.

History and Growing Research

The study of EI can be traced back to Darwinism's explanation of how EQ aids in adaptation and survival. However, the business world did not start paying attention to its relevance until the 1980s and 1990s. In 1995, the term Emotional Intelligence was conceptualized by Daniel Goleman, and numerous studies on the effects of emotional intelligence in the workforce have been conducted since the 1990s. For over three decades, research has supported the importance of social and emotional competencies as proven predictors of occupational effectiveness (Allam, 2011).

Components of EQ

Goleman identified five components of EI including the personal competencies of self-awareness, self-regulation, and motivation, and the social competencies of empathy and social skills (Jain, 2018). These competencies make up one's ability to identify and understand their own emotions as well as the emotions of others. The stronger a person's skill in each of these competencies, the stronger their EQ will be.

The first three competencies are personal, meaning that they relate to the emotions of the self. Self-awareness is the ability to recognize one's own emotions, moods, and feelings as they occur. Self-regulation is the ability to recognize and then manage emotions appropriately in a given context. This sometimes involves using techniques to alleviate negative feelings. Some techniques that can help with anger, anxiety, or depression are meditation, recasting the situation in a positive light, or taking a walk (Akers & Porter, 2003). The last of the personal competencies is motivation, which means to harness one's emotions to achieve goals (Allam, 2011). Motivation requires having clear goals and a positive attitude by noticing negative thoughts as they occur and reframing them in a positive way (Akers & Porter, 2003).

The last two competencies are social competencies, meaning that they relate to the emotions of others. Empathy is "being attuned to the signals that indicate what others need or want" (Allam, 2011, p. 73). Social skills involve developing good interpersonal skills and "dealing constructively with the emotions of others" (Allam, 2011, p. 73).

Advantages of EQ

Teamwork and Conflict Resolution

Using these personal and social competencies increases EI and results in stronger teamwork skills and conflict resolution. When employees are better able to manage their emotions and empathize with the emotions and desires of their team members, they are able to work more productively. According to Landale, "A study by Yale University, for example, found that teams with higher levels of EQ outperformed teams with low levels of EQ by a margin of two to one" (Landale, 2007, p. 24). He claims that today's work environment requires employees to build strong relationships with one another faster

than ever and "EQ is the glue that holds people and teams together" (Landale, 2007, p. 24). EI can also make teams more adept at brainstorming and creating products that utilize emotional intelligence for customer benefit. Zeidner et al. claim that "EI may be related to the social skills needed for teamwork, with high EI individuals particularly adept at designing projects that involve infusing products with feelings and aesthetics" (Zeidner et al., 2004, p. 386).

High EI also strengthens teamwork and productivity by reducing potential conflict among employees. Jain states that people with a high level of emotional intelligence are better at "empathizing with alternative views of people—an important attribute for preventing partitioning conflicts at work" (Jain, 2018, p. 160). When employees demonstrate empathy, they are able to understand why teammates behave the way they do. This knowledge allows them to get to the root of the issue and understand the needs of all team members and clients. The EI competency of self-regulation then helps them avoid lashing out unprofessionally or demonstrating an unproductive knee-jerk reaction. When conflict does arise, "EI enhances the possibility of usage of constructive conflict with significant correlations between collaboration and awareness of own emotions, discussion of own emotions, control of own emotions, recognition of own emotions, and management of others' emotions" (Dabke, 2016, p. 35). Increased EI results in stronger teamwork through better brainstorming, conflict resolution, saved time, and increased productivity.

Job Satisfaction and Commitment

High EI results in higher job satisfaction and job commitment among employees, allowing them to experience lower stress from challenges and job insecurity. This is because people with higher EQ possess the ability to think more positively and show more resilience in challenging situations than those with lower EQ. Being able to identify and regulate emotions results in employees who are more grounded and adaptable in stressful work environments (Allum, 2011). As Zeidner et al. state, "EI is claimed to influence one's ability to succeed in coping with environmental demands and pressures, clearly an important set of behaviors to harness under stressful work conditions" (Zeidner et al., 2004, p. 387).

Zeidner et al. also cite EQ's ability to equip employees to handle the stress of turbulent markets and job insecurity stating, "High EI employees are better able to deal emotionally with job insecurity and will be able to ameliorate the effect of job insecurity on their affective commitment. This frequently leads to increased work commitment and effort, positive coping behaviors (problem-focused), and reframing of perceptions of insecurity as an existing challenge" (Zeidner et al., 2004, p. 387. Employees who have higher EI are able to think more rationally when under emotional stress, making them more adaptable when problems arise and better able to positively assess situations that present challenges and pressure.

Leadership

High EQ also contributes to stronger leaders, resulting in further advantages for the workforce. Leaders who possess high EQ are seen as more effective by employees. This finding is confirmed by Dabke who writes, "Past research has also found a strong positive association between the leader's EI and subordinate's leadership effectiveness perception" (Dabke, 2016, p. 35). This is because leaders with high EQ are better at "accurately identifying how followers feel" and can "better appraise and influence followers' emotions so they are supportive of leaders' goals and objectives, thus insuring a shared vision" (Zeidner et al., 2004, p. 387). Emotional intelligence among leaders leads to a more cohesive, in-sync workforce because they can read the emotions of others to bring all parties on board.

Leaders with high EQ are also better at strategizing and prioritizing objectives and goals because they know how to take into account the emotions of all stakeholders and identify what is most important to them. As Zeidner et al. explain, "Leaders can use intense emotions as signals to direct their attention to issues in need of immediate attention and can use emotions to prioritize demands" (Zeidner et al., 2004, p. 387). This ability stems from the two EQ competencies of self-awareness and empathy because "those who understand their own emotions are likely to understand the emotions of others" (Rahim, 2019, p. 41). When leaders understand the emotions of others, they can make more strategic and timely agendas.

Lastly, high EI also results in leaders who can create a positive work environment. Because these leaders are tuned in to the emotions and needs of their subordinates, they are better able to "persuade them to work toward the attainment of organization's goals, promote harmony, and motivate others to learn, create a collaborative culture, and encourage team-building" (Rahim, 2019, p. 42). Employees who feel seen and understood by their leaders within an organization will feel a greater sense of support and respect, leading to higher morale and cooperation.

Profitability

It stands to reason that if EI strengthens teamwork, job satisfaction, motivation, and leadership within the workforce, it will, in turn, increase profitability. When employees know how to recognize and manage the emotions of themselves and others, they form cooperative relationships with team members and clients. This translates to higher profits. For an example of how the ability to manage personal emotion results in profitability, one study of a large public accounting firm showed that partners "with significant strengths in self management contributed 78% more incremental profit than partners who did not have these skills" (Akers & Porter, 2003, p. 68). Furthermore, the same study showed how powerful social competencies like social skills are in increasing profitability, revealing that "partners with strong social skills added 110% more profit than those with only self-management competencies. This results in a 390% incremental profit annually" (Akers & Porter, 2003, p. 68).

Conclusions

The personal and social competencies of EI or EQ equip those in the workforce to identify, understand, and regulate the emotions of themselves and others. This leads to significant benefits for the workforce including stronger teamwork, job satisfaction, leadership, and greater profitability. Although emphasis for predicting occupational success has historically been placed on one's intelligence or IQ, research of the past few decades supports the idea that EI is actually of greater value to the employee, managers, and companies at large. Through its five emotional competencies, EI equips employees and managers with the skills to form cooperative relationships, which are the foundation of business.

REFERENCES

Akers, M.D., & Porter, G.L. (2003). Your EQ skills: Got what it takes? *Journal of Accountancy, 195*(3), 65-69.

Allam, Z. (2011). Emotional intelligence at workplace: A psychological review. *Global Management Review, 5*(2), 71-80.

Dabke, D. (2016). Impact of leader's emotional intelligence and transformational behavior on perceived leadership effectiveness: A multiple source view. *Business Perspectives & Research, 4*(1), 27-40. **https://doi-org./10.1177/2278533715605433**

Jain, A. (2018). Holistic view of emotional intelligence in the workplace: View on utilization & benefits. *Journal of Services Research, 18*(2), 153-164.

Landale, A. (2007). Must have EQ. *Manager: British Journal of Administrative Management, 57,* 24-25.

Rahim, M.A. (2019). A model of emotional intelligence and job performance. *Applied Management Journal, 20,* 38-55.

Zeidner, M., Matthews, G., & Roberts, R.D. (2004). Emotional intelligence in the workplace: A critical review. *Applied Psychology: An International Review, 53*(3), 371-399. **https://doi-org./10.1111/j.1464-0597.2004.00176.x**

Coronavirus and Major Modes of Transportation: Issues, Impacts, and Outcomes

Jacob Bauch
M.S. Global Logistics and Supply Chain Management Major

ABSTRACT

The Coronavirus (COVID-19) pandemic has imposed unprecedented challenges on every aspect of the modern supply chain. From worker shortages to government regulations, every challenge imaginable seems to have arisen. Yet somehow, in the midst of extreme hardship, firms have found ways to innovate, adapt, and overcome. This statement is especially true for the transportation sector, which was arguably one of the hardest hit industries by the pandemic. This writing will explore some of the most significant challenges faced by the major modes of transportation, and the steps that firms operating in these modes took to remain afloat, help society heal, and improve moving forward. Further, this paper will review how the pandemic has changed certain aspects of transportation forever, and what the future might hold for this important link in the supply chain. Evidence, analysis, and findings will be presented for the unique topics at hand, and opportunities for additional examination will be suggested.

Introduction

Major modes of transportation (truck, rail, water, air) serve as the glue that holds the supply chain together. It is often overlooked just how crucial commercial transportation is to modern society. Essentially, if commercial transportation ceases to function, the world shuts down. There would be no way to transport food to grocery stores, fuel to gas stations, or clothing to retail shops. This nightmarish situation could have become a reality due to the COVID-19 pandemic. Facing a plethora of unprecedented challenges, firms operating in all four major modes of transportation were forced to adapt and figure out all new ways to conduct business in order to keep the world going. Some of these adaptations will end with the pandemic, but some are here to stay. By exploring the hardships overcome by the transportation sector, one will learn what the future of the industry will look like.

Trucking

Motor carriers are by far the most common way to transport goods, covering the "last mile" of most commercial shipments. So it is easy to see why this mode has been heavily impacted by COVID-19. At the beginning of the pandemic, from March 16 to May 8 of 2020, there had already been a significant drop in commercial transportation activity in the United States and Canada compared to baseline data from just one month prior (Del Gatto, 2020). However, the pandemic presented a huge uptick in online orders. This, combined with a lack of employees at pick-up and delivery locations, has constrained schedules and increased delivery times. Further, the closures of restaurants, restrooms, and rest areas have forced truckers to take alternate and often slower routes. In an effort to offset the schedule delays caused by these challenges, the Federal Motor Carrier Safety Administration lifted regulations that imposed a maximum of 11 working hours during a 14-hour workday. Drivers were also exempt from typically required 30-minute breaks and the regular 34-hour restart rule (Del Gatto, 2020). These emergency exemptions kept continuity in the trucking industry and provided additional relief to drivers and their companies.

Ensuring the health of drivers has also been a significant struggle for trucking firms. Drivers have understandably expressed concerns over the well-being of themselves and their families, and cases have even been reported of drivers being told by their firms to self-quarantine in their trucks after experiencing COVID symptoms (Del Gatto, 2020). This has placed trucking companies in unexplored waters. To mitigate the concerns of drivers and keep them safe, companies have ramped up their education on the sanitization of hands and equipment, as well as social distancing. Hotlines have also been put into place to help drivers navigate health questions, take safety measures, and even communicate with stops along drivers' routes to ensure safety protocols are followed (Pyzyk, 2020). Further, pick-up and drop-off locations have begun administering temperature checks before allowing drivers to enter facilities. Some have even begun requiring drivers to remain inside the truck while facility employees load or unload the shipment (Pyzyk, 2020).

Already facing a significant driver shortage and an above average employee age compared to most other careers, COVID-related hardships have made motor carriers look more seriously into what the future of the industry will look like. The increase in online orders, and thus demand for last-mile deliveries, has prompted firms to explore emerging technologies that could provide them a competitive advantage and offset driver shortages. The implementation of innovations such as driverless trucks and other autonomous technologies may arrive sooner than expected, assisted by the pandemic acting as a catalyst. Moreover, innovations being made to limit face-to-face interactions with drivers, such as touchless proof-of-delivery methods, are also on the rise as a result of the coronavirus. While emergency exemptions will not last forever, updated safety protocols and technological innovations are likely here to stay. Lastly, even through all of the challenges motor carriers have faced, they still have been able to serve as one of the most important pieces in the nation's pandemic recovery. By transporting much needed medical equipment, supplies, vaccines, and other forms of aid to locations all over the world, the trucking industry has made a remarkably positive impact on society during this crisis.

Rail

The outbreak of the coronavirus has placed a massive restraint on rail transport, as governments have imposed lockdowns and restricted the movement of both people and goods. Rail transport serves as a huge player in the movement of both cargo and passengers, so it is no surprise that rail workers were deemed essential to America's functioning during the pandemic. Firms on both sides of the rail industry have been taking every step possible to keep the trains on the tracks. This started with ensuring the health and well-being of rail employees. Rail carriers have put forth a significant effort to edu-

cate their employees on things such as virus-related news, social distancing strategies, expanded cleaning and sanitation policies, and enhanced health benefits ("How America's Freight Railroads Are Responding," 2021). Furthermore, as with many other industries, the demand for rail transport has dropped, causing profit loss and leading to layoffs. Since railroad workers do not receive unemployment benefits through state-administered programs, the rail industry successfully urged Congress to provide railroad workers with the same enhanced benefits they have extended to other citizens through COVID-19 stimulus packages ("How America's Freight Railroads Are Responding," 2021).

The aforementioned steps taken by the rail industry to keep their employees safe during the pandemic has enabled them to transport critical goods to places desperately needing them during the outbreak. These goods include chemicals for medicines and food packaging, disinfectants for water treatment, fertilizers for crops, oil for heating and gas, and store-bought products like toilet paper and sanitization supplies ("How America's Freight Railroads Are Responding," 2021). Moreover, although the pandemic has brought about tremendous hardships for rail transport, it has also presented some unique opportunities for innovation. A recent report from the UBS investment bank found that since the pandemic has been grounding planes and ravaging airline finances, other forms of international travel, like rail, might be the beneficiaries (Love, 2020). UBS predicts that world air traffic growth will decrease from 5.1% to 4.6% over the next 10 years, and that there will be 800 more bullet trains running in Europe within the next decade, while 196 fewer planes will be needed. Additionally, the European Commission is dubbing 2021, "The European Year of Rail." As part of the European Green Deal, multiple initiatives have been implemented to portray rail travel as an environmentally friendly form of travel (Love, 2020). Despite the many challenges the rail industry has been facing of late, the future is bright. Whether it be increased demand for passenger rail travel, technological advancements in rail cargo transport, or increased health and safety requirements, the rail sector will have a different look in the near future that was shaped by the pandemic.

Water

Global maritime transport has been no exception when it comes to the disruption of the coronavirus, but the industry foresees a return to growth in the near future. Mukhisa Kituyi, CEO of the United Nations Conference on Trade and Development, stated, "The global shipping industry will be at the forefront of efforts towards a sustainable recovery, as a vital enabler of the smooth functioning of international supply chains" ("COVID-19 Cuts Global Maritime Trade, Transforms Industry," 2020). However, this recovery will not come easy. Many changes have been made in the industry since the start of the pandemic. First, the decrease in cargo volume forced shippers to cut capacity and reduce costs, shifting their focus to maintaining profits rather than market share. Although this allowed them to keep rates static, it meant less space for transport and slower delivery times. As expected, the industry had to alter their procedures, finances, and health protocols to keep ships moving and employees safe ("COVID-19 Cuts Global Maritime Trade, Transforms Industry," 2020). To help with this, many governments implemented emergency regulations to enable trade to continue moving while keeping workers safe.

So how has COVID-19 sparked innovation in the global maritime transport industry? It has bolstered the case for technological advancements and the need to eliminate direct contact and paperwork in the industry. The need for increased electronic documentation has never been higher, sparking additional investments by shippers in the realm of automation and digitalization. For example, shippers have begun partaking in practices like accepting digital copies of documents in lieu of originals, accepting electronic payments, and automating customs processes ("COVID-19 Cuts Global Maritime Trade, Transforms Industry," 2020). These practices not only help keep people safe, they also improve speed and efficiency, cut costs, and promote industry growth. The United Nations Conference on Trade and Development predicts that maritime trade growth will expand by 4.8% in 2021, but the accuracy of this prediction hinges upon the industry's innovations and preparedness to operate in a transformed post-pandemic environment ("COVID-19 Cuts Global Maritime Trade, Transforms Industry," 2020).

Air

Air transport has been one of the hardest hit sectors by the coronavirus. Demand for both air cargo and passenger transport has dropped, and capacity has decreased significantly. Vladimir Zubkov, Secretary General of The International Air Cargo Association, said, "The impact on the worldwide cargo logistics industry is significant and will affect the industry's ability to recover from COVID-19" (Zubkov, 2020). However, air carriers are still continuing to find ways to overcome adversity and keep society connected. For starters, as the fastest mode of transportation, air cargo has been pivotal in transporting time-sensitive materials globally, such as medical equipment, sanitation supplies, and vaccines. Air carriers have also been innovating by utilizing passenger aircrafts for more capacity in the transport of important cargo, due to the reduced amount of passenger flight demand ("Action Cargo: COVID-19," 2021). Carriers have also been active in providing much needed relief flights for some of the world's most affected locations.

Air carriers, along with the International Air Transport Association, have worked with the World Customs Organization to minimize border blockages so that aircrafts can deliver essential goods. Moreover, the United States provided vital financial support for both cargo and passenger air carriers through the signing of the Coronavirus Aid, Relief, and Economic Security (CARES) Act ("Action Cargo: COVID-19," 2021). Governments have also made efforts to reduce cargo aircraft parking and landing fees in order to keep supply chains active and crucial goods moving. Additionally, steps have been taken to make cargo flights exempt from transport restrictions, as well as to exempt cargo crews from travel and quarantine requirements. Air transport will continue to serve as an unparalleled tool for the movement of time-sensitive materials, especially during uncertain times like the pandemic. In order to fully recover and come back stronger than before, air carriers must build upon their COVID-19 related innovations and use them to establish competitive advantages and continue improving society.

Conclusion

Supply chains will be forever altered from the coronavirus pandemic, especially for the transportation industry. Changes in customer preferences, alterations to firms' operations, and a new outlook on health and safety are just a few of the permanent differences in the post-pandemic supply chain that transportation firms of all modes will have to adapt. With this being said, ample useful innovations and ideas that transportation

firms have birthed during the pandemic will certainly be here to stay. Firms who successfully leverage these newfound innovations to build a long-term competitive advantage will be the firms that thrive into the future. An opportunity for further research lies within which of these innovations will help shape and define transportation in the post-pandemic supply chain. Time will surely tell.

REFERENCES

Action Cargo: COVID-19. (2021). International Air Transport Association, 2021. **www.iata.org/en/programs/cargo/**

COVID-19 Cuts Global Maritime Trade, Transforms Industry. (2020, November 12). United Nations Conference on Trade and Development. **unctad.org/news/covid-19-cuts-global-maritime-trade-transforms-industry**

Del Gatto, B. (12 Nov. 2020). COVID-19: Symptoms felt across the trucking industry. *The National Law Review.* **www.natlawreview.com/article/covid-19-symptoms-felt-across-trucking-industry**

How America's Freight Railroads Are Responding. (2021, July 13). Association of American Railroads. **www.aar.org/campaigns/freigh-railroads-covid-19/**

Love, A. (2020, August 11). Covid-19: Could the pandemic bolster international rail travel? *Railway Technology.* **www.railway-technology.com/features/covid-impact-railways/**

Pyzyk, K. (2020, June 22). How the coronavirus pandemic might reshape trucking's future. *Transport Topics.* **www.ttnews.com/articles/how-coronavirus-pandemic-might-reshape-truckings-future**

Zubkov, V. (2020, April 28). How is the air cargo industry responding to the COVID-19 pandemic? *International Airport Review.* **www.internationalairportreview.com/article/115426/air-cargo-industry-reacting-responding-covid-19/**

Cold Supply Chain Innovations within Food Industry Transportation and Distribution

Keatha Davenport
M.S. Global Logistics and Supply Chain Management Major

ABSTRACT

Effective cold chain management is a critical part of transportation and distribution service when it comes to managing the temperature of perishable products such as food and pharmaceuticals. Without the appropriate standards in place, the public's health can be put at risk for consuming or receiving low-quality products. Transporting perishable goods dates back centuries to when there was little technology or ways to move items long distances across the country. Presently, more vehicles have been designed to transport these valuable items more frequently, more safely, and over longer distances. Many regulations must be followed for the food industry to remain in compliance with government food entities when moving perishable goods. This paper will explore complexities incurred through CC transportation and distribution in the food industry. It will also discuss the technological innovations such as packaging materials, the Internet of Things (IoT), and Radio-Frequency Identification (RFID) tags that are currently used to sustain the integrity of products shipped locally and globally.

Introduction

Concerns about the growing population have encouraged many to reevaluate how food supply industries will need to revamp their strategy to accommodate this growth. Over 1.3 billion tons of food is wasted every year worldwide (Shashi et al., 2018). One of the reasons this massive amount of money and food is being wasted is due to the lack of effective Cold Chain Management. Cold chain describes a particular supply chain whose processes ensure the temperature control for perishable items (Shabani et al., 2015). The purpose of this paper is to discuss how cold chain has revolutionized the food industry and how it has evolved into a complex series of processes to bring perishable items to customers and consumers across the globe in a high-quality state while maintaining compliance with government regulations and industry standards.

Reasons for Cold Chain Development

Food freshness is critical in supply chains. When perishable foods are improperly kept due to lack of appropriate refrigeration, the growth of pathogens and spoilage microorganisms causes the product to become inedible (Mercier et al., 2017). The origins of storing and transporting perishable food date back to the 18th century as British fishermen preserved the freshness of their daily catch of fish by packing them on ice. This method, along with many others like canning, drying, and storing food in root cellars, went on for decades. With the advancement of motor vehicles, more roadway construction, and more demand on the food supply chain, engineers designed refrigeration systems for trucks to carry perishable foods for longer distances.

Limited cold storage equipment and neglected transportation in underdeveloped countries have contributed to inefficient systems used in their cold chains. Different countries possess various abilities to keep goods cold during transport (Mercier et al., 2017). Because of the extensive population growth predicted by scientists to occur in the next three decades, the use of innovative technology in the cold chain will mitigate such a significant loss of perishable items during transportation, storage, and distribution. Modern technology software and hardware is currently being applied to cold chain systems to monitor and control temperatures inside various modes of transportation and have aided in reducing the loss of perishable products. Li and Pan (2021) explain, "In order to deliver high-quality food to consumers, thorough real-time temperature monitoring and management is required at each stage of production, processing, circulation, and consumption."

Methods of Transportation in Initial Stages of Development

Before transportation methods such as motor vehicles, airplanes, trains, waterways, and pipelines were developed, humans relied on either transporting perishable goods by foot or horse and carriage. With society becoming more developed and advanced, many distributors made use of rail cars, steamships, and warehouses to provide temperature-controlled environments for food storage. This would typically involve using ice as a means to control temperature, lessening food spoilage. When the 20th century arrived, vehicles such as refrigerator cars were designed to travel on railways to shops around the United States. Depending on the types of products it carried, blocks of ice, mechanically refrigerated systems, or dry ice were used as cooling agents. He and Li (2014) refer to railway transportation as one of the major modern transport modes. "Rail transport has advantages of convenient, low cost, energy consumption, safety, reliability, high punctuality rate, and strong continuity, and occupies an extremely important position in the transportation industry" (He & Li, 2014). Railways were an extremely effective way of transporting perishables around the country and became even more efficient with the development of express refrigerator cars which carried products with a shorter shelf life such as fish, milk, and fruits.

Refrigerated cargo shipping emerged during the late 1800s in the United States. These vessels were also called reefer ships. The most important chilled cargo at that time was meat. To transfer meat, workers would freeze it into a mixture of salt and ice. It would then be transported to port terminals located in southern parts of the country. The typical storage location for perishables was in refrigerated holding decks below these vessels. Reefer or refrigerated containers replaced reefer ships in the 1960s. They were designed to move temperature-controlled perishables by intermodal. With more frequent transportation activity of perishables and the breakthrough development of refrigerated containers, the more expensive distribution became, due to energy consumption during trips to ports overseas. Cooling expenses could potentially vary 15% to 50% depending on the temperature of the transported cargo and the conditions of the external environment in route to its

destination (Filina-Dawidowicz & Filin, 2019). For this reason, maintaining an efficient and effective system of product movement is imperative in the cold chain.

Description of Typical Cold Chain Products

Around 70% of food consumed in the United States is handled by the cold chain. Food temperature requirements are unique and based on their method of processing. Storage and distribution facilities for grocery centers, shops, and restaurants encounter various challenges when mapping out the optimal environment for these perishable products as they may be of mixed variety like frozen foods, fresh vegetables, dairy, and eggs. Personnel must pay close attention to detail when deciding where in a warehouse frozen versus freshly cut produce are stored. Monitoring food products that have been exposed to changes in temperatures is among the highest priority of components in the cold chain (Mercier et al., 2017).

In industries such as pharmaceuticals, the cold chain is a crucial part of how it moves products that require a temperature-controlled environment. As COVID-19 continues its unprecedented disruption to healthcare operations and its fatal impact to human life, it is essential that vaccine developers like Pfizer and Moderna distribute their temperature-sensitive drugs locally and globally, so that they are suitable for their intended use. Drugs such as vaccines, insulin, and blood must remain at appropriate temperatures to prevent spoilage, the loss of potency, or to prevent toxicity. More pharmaceutical companies are emerging with new drugs and biological discoveries which contribute to markets in this industry's growth. These companies need to assure they have control over payload temperatures so the quality can be protected and have little loss of product to keep up their profitability (Forcinio, 2014).

Technological advancements are allowing the successful transportation of drugs from manufacturing facilities to their appropriate destinations. Containers packed with several millions of small fragile glass vials are shipped daily from drug manufacturing facilities across the country to combat the global spread of deadly diseases. The World Health Organization (WHO) expresses that COVID-19 vaccines can be stored in a system that maintains them in good condition, implying the recommended temperature ranges (i.e., 2 to 8°F or -15 to -25° C) (AboulFotouh et al., 2021). Transporting vaccines through regions of the world with deplorable infrastructure creates challenges for aid workers, in particular, at the last mile of delivery. Active refrigeration systems, for example, off-grid refrigerators called solar direct-drive or SDD, are solar powered directly from solar panels requiring no battery (Robertson et al., 2017). This advanced system allows refrigerators loaded into vehicles the ability to be powered with little effort, using only the sun's energy. Although SDD has given gradual progress to cold chain transportation methods, work is still needed to monitor temperatures and package these drugs for long-haul deliveries.

FDA Regulations in Shipping Perishables

Any warehouse operating as a food storage facility must follow regulations set by the Federal Drug Administration (FDA). This government entity regulates the condition and treatment of food products to ensure the nation's food supply is safe. Certain standards must be met and maintained to qualify food as safe to eat. Processing facilities have to be registered with the FDA, and inspections of these facilities occur regularly. Food transportation is also regulated by the FDA. There are guidelines in place for perishable products, milk in particular. A FDA guidance document suggests ways that dairy farmers and distributors can prevent tampering of their products while in transport and encourages them to report incidents where they may feel a more structured guide should be used to improve safety practices among the food supply. It has created a flexible approach that allows the carrier and shipper to decide on an agreeable mechanical method of monitoring the temperature of products during transport (Maras, 2016). Several records have to be kept when transporting food, like origin and destination points, route of movement during transportation, and a description of the freight being carried.

Public Health Risks

The public's health is a main concern for the government. A breach in the cold chain occurs when the temperature of a monitored product falls below or increases above the storage specifications. Mercier (2017) identified perishable food as a challenge to maintain in the desired range when applying it to every step of the cold chain. The food industry must use reliable transportation with temperature monitors to reduce the likelihood of a consumer ingesting food that contains bacteria that can result in illness or even death. Medicines essential to a patient's functionality have higher chances of loss due to power outages that can cause a break in the cold chain (Kosari, 2018). Pharmaceutical industries must remain vigilant when controlling products as well. Diseases such as COVID-19 have created an urgent need to transport vaccines globally to administer to high-risk individuals. Sustaining proper exchanges within the cold chain will help prevent medicines from losing their potency or mitigate the chances of a medicine causing a negative reaction to a consumer's biological system.

Transportation Differences

Transportation techniques differ in a cold chain when compared to a typical supply chain. As mentioned earlier, goods are transferred using refrigerated vehicles. Finding a refrigerated vehicle company may also be more difficult on the logistics side of cold chains due to more limited availability. Different costs are measured when deciding modes of transportation. Typical supply chains use cost and time to decide their shipping mode, whereas cold chains use cost and perishability. Precise detail comes with planning routes for moving products like fresh vegetables from growers to warehouses. Several stops throughout a route can compromise the integrity of a product. Luo et al. (2016) articulate that specialized warehousing with refrigeration units in facilities are required to maintain temperature control During the loading and unloading of products at warehouses, employees must remain watchful of the time spent performing these tasks. Refrigerated vehicles' cooling mechanisms must remain powered on, and products should immediately be removed from docks when unloaded and stored in their appropriate temperature-controlled areas.

Innovations in Packaging Material

Innovations in technology play one of the most important roles in maintaining a productive transportation and distribution system in the food industry. Cold chain management depends on innovative technology to mitigate the loss of perishable items. Billions of dollars are wasted when food does not reach customers or it is deemed inconsumable due to temperature discrepancies. To prevent these numbers from rising, many more organizations are focusing on a variety of technical solutions to aid in observing how well their current refrigerated transportation is performing. According to Luo et al. (2016), Real-time monitoring of temperature, humidity, and physical position is vital to cold chain systems. Packaging materials

hold a great value in the safety of food and other cold chain products. Cold temperature box sealing tapes are designed to withstand temperatures of -40°F. Adhesive temperature indicators are used as a less expensive way to detect if a product has reached an undesired temperature while in transit. It is attached to packed products and is read once the final destination has been reached. Foams and gel packs are essential for smaller loads. Insulated pallet covers are also useful when shipping larger loads.

The Internet of Things (IoT)

The Internet of Things (IoT) applications to software make real-time visibility possible. With the IoT, food industries get an uninterrupted cold chain infrastructure in all stages of the supply chain. Users can apply sensors and actuators to a product that connects to the internet and shares data (Tsang et al., 2018). Temperature is monitored continuously, and real-time historical data is kept in these systems. Organizations can keep track of where vehicles are located on their route. Systems are able to alert personnel of issues that can be fixed while perishables are in transit. Employees and management can all gain access to information through computers as well as electronic devices such as phones or tablets. Analytical data can be stored within these systems to provide markers where improvement is needed.

Radio-Frequency Identification (RFID) Technology

Accurate traceability of foods, products, and supply storage locations is becoming necessary for food industries to maintain their compliance with food safety standards. Radio-Frequency Identification (RFID) Technology allows better control over locating and handling temperature-sensitive foods. Vivaldi (2020) states that "technologies such as Bluetooth and Radio-Frequency Identification (RFID) allow the temperature monitoring with a direct access of packagings." RFID technology helps the food industry keep track of where products are located without having physical contact with them. This reduces the likelihood of products becoming contaminated while being unloaded from vehicles. Pallets or boxes are scanned to identify the location, then stored where needed. Tags can also be applied to products with adhesives to monitor temperatures in real-time and can withstand below freezing conditions. Software used with RFID technology can track deliveries and send reports between facilities.

Conclusion

Cold chain is vital to industries that provide services to restaurants, shops, grocery stores, hospitals, florists, and more. Transporting and distributing perishables is a complex task that requires constant advancement in technology. With the growing human population worldwide, there will always be a demand for supplies, food, and other goods to be delivered on time and in excellent condition. Government regulations have made contributions to assure consumers are getting safe products, and organizations such as food industries are using technology to get a better understanding of their cold chain transportation methods and how to improve them. This, in turn, will help lower the massive amount of food wasted every year around the world.

REFERENCES

AboulFotouh, K., Cui, Z., & Williams, R.O. (2021). Next-generation COVID-19 vaccines should take efficiency of distribution into consideration. *AAPS PharmSciTech, 22,* 126. **https://doi.org/10.1208/s12249-021-01974-3.**

Filina-Dawidowicz, I., & Filin, S. (2019). Innovative energy-saving technology in refrigerated containers transportation. *Energy Efficiency, 12*(5), 1151-1165. **doi:http://dx.doi.org.athens.idm.oclc.org/10.1007/s12053-018-9729-2.**

Forcinio, H. (2014). Packaging addresses cold-chain requirements. *Pharmaceutical Technology, 38*(1), 78-82. **https://athens.idm.oclc.org/login?url=https://www-proquest-com.athens.idm.oclc.org/trade-journals/packaging-addresses-cold-chain-requirements/docview/1628649948/se-2?accountid=8411**

He, H., & Li, D.W. (2014). Research on the problems of China's railway refrigerated transport and solutions. *Applied Mechanics and Materials, 505-506,* 562-566. **doi:http://dx.doi.org.athens.idm.oclc.org/10.4028/www.scientific.net/AMM.505-506.562**

Kosari, S., Walker, E.J., Anderson, C., Peterson, G.M., Naunton, M., Castillo Martinez, E., Garg, S., & Thomas, J. (2018). Power outages and refrigerated medicines: The need for better guidelines, awareness, and planning. *Journal of Clinical Pharmacy and Therapeutics, 43*(5), 737-739. **https://doi.org/10.1111/jcpt.12716**

Luo, H., Zhu, M., Ye, S., Hou, H., Chen, Y., & Bulysheva, L. (2016). An intelligent tracking system based on internet of things for the cold chain. *Internet Research, 26* (2), 435-445. **doi:http://dx.doi.org.athens.idm.oclc.org/10.1108/IntR-11-2014-0294**

Maras, E. (2016). Are you ready for the FSMA? The Food and Drug Administration takes a non-prescriptive approach to improving food safety. *Food Logistics,* (179), 18. **https://link.gale.com/apps/doc/A463399774/ITBC?u=naal_athens&sid=ITBC&xid=ccf5c8db**

Mercier, S., Villeneuve, S., Mondor, M., & Uysal, I. (2017). Time-temperature management along the food cold chain: A review of recent developments. *Comprehensive Reviews in Food Science and Food Safety, 16*, 647-667. **https://doi.org/10.1111/1541-4337.12269**

Robertson, J., Franzel, L., & Maire, D. (2017). Innovations in cold chain equipment for immunization supply chains. *Vaccine, 35*(17), 2252-2259. **doi:http://dx.doi.org/10.1016/j.vaccine.2016.11.094**

Shabani, A., Torabipour, S.M.R., & Saen, R.F. (2015). A new super-efficiency dual-role FDH procedure: An application in dairy cold chain for vehicle selection. *International Journal of Shipping and Transport Logistics, 71*(4), 426-456.

Shashi, R.C., Singh, R., Centobelli, P., & Shabani, A. (2018). Food cold chain management: From a structured literature review to a conceptual framework and research agenda. *International Journal of Logistics Management, 29*(3), 792-821. **https://doi-org.athens.idm.oclc.org/10.1108/IJLM-01-2017-0007**

Tsang, Y.P., Choy, K.L., Wu, C.H., Ho, G., Lam, C.H.Y., & Koo, P.S. (2018). An internet of things (IoT)-based risk monitoring system for managing cold supply chain risks. *Industrial Management & Data Systems, 118*(7), 1432-1462. **doi:http://dx.doi.org.athens.idm.oclc.org/10.1108/IMDS-09-2017-0384**

Vivaldi, F., Melai, B., Bonini, A., Poma, N., Salvo, P., Kirchhain, A., Tintori, S., Bigongiari, A., Bertuccelli, F., Isola, G., & Di Francesco, F. (2020). A temperature-sensitive RFID tag for the identification of cold chain failures. *Sensors and Actuators A: Physical, 313.* **https://doi.org/10.1016/j.sna.2020.112182**

The Benefits of Blockchain Technology in Supply Chain Management

Jacqueline Allison
M.S. Global Logistics and Supply Chain Management Major

ABSTRACT

Supply chain management professionals seek beneficial software solutions that support operational and strategic objectives, such as blockchain technology. Therefore, this study aims to prove the benefits of blockchain technology in supply chain management. Specifically, blockchain technology creates collaboration, coordination, transparency, and traceability in supply chain management. This study reviews past literature from scholarly articles to analyze the benefits of applying blockchain technology in supply chain organizations. The study demonstrates how blockchain technology produces a collaborative environment and improves coordination capabilities, data transparency, and product traceability. Therefore, the results show that blockchain technology is a beneficial resource for mitigating risks and gaining opportunities in supply chain management. Thus, supply chain organizations will benefit from implementing blockchain technology to promote strategic initiatives and achieve a competitive advantage. However, while beneficial, blockchain technology may be met with resistance during implementation, as innovative software may be a barrier for new users. For this reason, future research on blockchain technology should investigate the effects of implementation among new users.

Introduction

Currently, organizations are pursuing innovative software solutions to effectively manage transactions and mitigate market impacts, thus gaining a competitive advantage. Fortunately, blockchain technology offers an innovative solution to start a revolution in supply chain management. According to Lumineau et al. (2021), blockchain technology was introduced in 2008, emphasizing the bitcoin application and expanding to provide a decentralized distributed network opportunity for organizations. Since its expansion, blockchain technology is emerging in supply chain management to automate operational tasks while gaining strategic opportunities among supply chain partners. Specifically, blockchain technology is beneficial as it creates collaboration, coordination, transparency, and traceability in supply chain management. Therefore, let us examine how blockchain technology improves supply chain operations through collaboration.

Analysis

Collaboration

Blockchain technology is beneficial to supply chain partners as it creates a collaborative supply chain environment that fosters communication and awareness. For example, through technological advancements, supply chain partners benefit from establishing alliances through the blockchain network and reaching new unreachable business opportunities when operating in independent networks (Bedin et al., 2021). In this situation, blockchain technology establishes a shared environment for supply chain partners to interact and build relationships, thus creating opportunities to optimize and synchronize supply chain operations jointly instead of independently. Furthermore, supply chain partners collaborate through the blockchain by jointly combining resources to reach new markets and leverage distribution networks, thus sharing risks and costs while gaining opportunities. For these reasons, supply chain partners must implement blockchain technology to establish the domain for collaborative relationships.

Integration

Blockchain deployment is essential to the supply chain as it generates an integrative ecosystem, thus producing immediate collaborative benefits between supply chain partners. For instance, once aligned, the supply chain will have the opportunity to synchronize capabilities while gaining strategic advantages across all activities in the blockchain (Wu et al., 2006, as cited in Madhani, 2021a). In this instance, supply chain partners experience significant outcomes through integrative networks by instantly gaining accessibility and streamlining competencies, thus automating processes and activities to achieve long-term advantages. Therefore, as you can see, blockchain should be deployed immediately to attain integrative data flow channels while increasing collaborative benefits among supply chain partners.

Information Sharing

Blockchain technology will support the ease of information sharing while maximizing collaborative efforts among supply chain partners. For example, blockchain champions the exchange of information through the interoperability of systems to maximize the seamless flow of information across the supply chain, thus providing readily accessible and authenticated data to entities within the network (Madhani, 2021a). In this situation, blockchain technology declares the functionality to connect supply chain systems and data, thus creating a reliable and simple data exchange to support supply chain partners' activities and demands within the network. Furthermore, blockchain confirms the authenticity of the data, thus eliminating the need to reconcile and validate data before exchanging information with supply chain partners. In short, blockchain technology is essential to providing the supply chain with the ability to exchange information confidently and effortlessly.

Trust

Through blockchain implementation, the supply chain will benefit from the trust attained within the network to collaborate openly among network users. For instance, blockchain is considered a trustless system as users cannot manipulate data, thus alleviating the need to establish trust with supply chain partners and providing access to reliable data within the network to foster collaboration (Pournader et al., 2020). Therefore, blockchain technology benefits supply chain partners who do not need to gain trust before engaging in activities or initiating transactions. The trustless system supports the ability to

collaborate in confidence among network users. Undoubtedly, the trustless system provided by blockchain technology is vital in helping trustworthiness among supply chain partners.

Furthermore, supply chain partners will benefit from the pooled trust measured in the blockchain while assessing and monitoring users' reputational ratings. Blockchain technology offers reputation systems that allow users to rate each other based on transactional exchanges, thus establishing credibility within the network while building a dependable environment (Bragadeesh et al., 2020; Hoetker & Mellewight, 2009, as cited in Lumineau et al., 2021). Therefore, the blockchain provides the assessment capability through a reputation grading tool to evaluate users based on transactional performance, thus determining a trust level within the network. In short, the reputation system provided by blockchain technology is critical to further confidence among supply chain partners. While blockchain technology improves collaboration, it is also responsible for improving coordination within a supply chain organization.

Coordination

Supply chain partners will benefit from the coordination capabilities within the blockchain. Through cooperation, blockchain supports the ability of supply chain partners to reduce ambiguity by planning and facilitating activities within the network, thus achieving optimal performance objectives (Lumineau & Henderson, 2012, as cited in Madhani, 2021a). Therefore, blockchain can tactically coordinate activities, which benefits the supply chain by minimizing uncertainty and increasing performance. Ultimately, reducing doubt in the supply chain can potentially achieve cost savings. For these reasons, blockchain technology is necessary to provide the supply chain with the strategic capabilities to coordinate activities while achieving potential cost-saving benefits.

Distributed Ledger

Through distributed ledger technology, supply chain partners will benefit from the effortless coordination of transactions within the blockchain. Specifically, blockchain technology is a distributed ledger that coordinates and documents all data transactions by a mutual consensus of partners within a network (Pardeshi, 2021; Yiu, 2021). In this situation, the distributed ledger technology is beneficial to supply chain partners by providing the ability to distribute and synchronize transactions smoothly between partners within the network, thus removing the need to coordinate transactions with an intermediary. The ability to remove an intermediary while coordinating transactions is significant, as supply chain partners will streamline communications and gain process efficiencies. Therefore, blockchain technology should be deployed to attain seamless transactional benefits within a distributed ledger and eliminate the need for an intermediary between supply chain partners.

Responsive

The supply chain will benefit from responsive interactions within the blockchain while increasing coordination and customer satisfaction. For instance, blockchain technology allows the supply chain to oversee data and conduct decision-making initiatives while monitoring shipments, thus minimizing response time by shipping a replacement product immediately when necessary (Ehsan et al., 2022; Pardeshi, 2021). In this instance, blockchain delivers the capability to manage product data, which provides the supply chain with the flexibility to act on strategic insights observed in real-time while monitoring shipments, thus increasing responsiveness and minimizing customer satisfaction impacts. Therefore, blockchain allows the supply chain to be proactive instead of reactive, thus optimizing supply chain performance. For these reasons, supply chain partners must implement blockchain technology to achieve optimal data coordination while maximizing responsiveness to meet or exceed customer expectations.

Smart Contracts

Efficient tools, such as smart contracts within the blockchain, will optimize coordination capabilities while reducing oversight from supply chain intermediaries. Specifically, smart contracts within the blockchain utilize automation to enable and administer agreements based on previously negotiated terms and promote the coordination of reliable transactions without the involvement of supply chain partners (Cole et al., 2019). In this instance, blockchain technology offers smart contracts capabilities, which optimize supply chain coordination by seamlessly automating the enforcement and facilitation of digital contract agreements while reducing the contributions and interventions of supply chain partners. Therefore, supply chain partners must implement blockchain technology to leverage the benefits of advanced tools, such as smart contracts, while achieving coordination capabilities and minimizing involvement in contractual agreements. In addition to coordination, blockchain provides transparency throughout the supply chain.

Transparency

Since blockchain stores all data transactions, the supply chain will benefit from accessing transparent data, thus providing accountability among supply chain partners. For example, the blockchain offers data transparency as partners can access and distribute data from a product's point of origin through the product's delivery (Cole et al., 2019; Stoica et al., 2019). In this instance, blockchain provides apparent end-to-end data access to allow supply chain partners to monitor upstream and downstream activities, thus providing the insights necessary to hold partners accountable for supply decisions. For these reasons, blockchain technology is critical to delivering the supply chain with transparent data while gaining strategic insights and encouraging accountability among partners.

Data Availability

Blockchain technology will benefit the supply chain by offering transparency through data availability. For example, the blockchain's ability to provide automation and access to data has considerably reduced procurement cycle time, thus reducing the time to contract award (Nayak & Nguyen, 2018, as cited in Lumineau et al., 2021). In this instance, access to real-time data in the blockchain proves to be valuable to the supply chain by increasing procurement performance through an understood decrease in procurement cycle time and time to contract award. Furthermore, reducing procurement cycle time is beneficial to the supply chain as process efficiencies will generate time-saving advantages. Ultimately, supply chain partners must implement blockchain technology to achieve optimal data transparency and availability while maximizing procurement performance through process efficiencies.

Productivity

Technological advancements, such as blockchain, will provide the transparency and automation necessary to enhance productivity in the supply chain. This is achieved in the blockchain using smart contracts, as supply chain partners can eliminate manual processes as the blockchain automatically initiates and processes transactions, thus increasing the operational throughput of the supply chain to focus on additional objectives (Cole et al., 2019). In this example, the supply chain can remove inefficient manual transactions by using smart contract to increase productivity through efficient automated transactions. Furthermore, by improving process efficiency, the supply chain will increase competitiveness. In short, the elimination of manual processes is achievable through blockchain technology, as automation will create process efficiency and competitive advantages for the supply chain.

Through transparency, the blockchain will improve the efficiency and effectiveness of the supply chain, thus providing process benefits across the network. Specifically, the blockchain reduces cost through an established transparent framework that supports the efficiency and effectiveness of process improvements by improving cycle times, reducing processing errors, and increasing quality performance (Madhani, 2021b). In this situation, blockchain technology increases productivity through efficient and effective process improvements, thus gaining several beneficial supply chain outcomes. In addition, the ability to operate within a cohesive network establishes the basis for synchronization among supply chain partners. Therefore, as you can see, supply chain partners must implement blockchain technology to achieve optimal efficiency and effectiveness available through automation. Furthermore, like transparency, blockchain improves traceability to strengthen and support supply chain management decision-making.

Traceability

Blockchain technology will alleviate uncertainty in the supply through product traceability. As evidence, blockchain provides supply chain partners with the ability to mitigate the bullwhip effect, as product traceability delivers insights into demand and inventory data to increase confidence in decision-making and support strategic planning opportunities (Madhani, 2021b). In this example, blockchain has proven capable of providing product traceability to analyze demands and evaluate inventory levels to make strategic decisions while avoiding the bullwhip effect in the supply chain, Thus, product traceability mitigates demand distortion, thus reducing risks while gaining predictability. For these reasons, blockchain technology is critical to providing the supply chain with product traceability while gaining strategic insights and assurance among partners.

Security

Blockchain technology will mitigate data security risks within the supply chain by establishing traceability in a secure information network. Specifically, the blockchain establishes security by using consensus algorithms that produce network-verified transactions and cryptography to secure data while connecting blocks within the chain to provide valid, traceable, and trustworthy data to supply chain partners (Maslova, 2018). In this situation, blockchain utilizes consensus algorithms and cryptography to verify and secure data transactions within the network. Therefore, blockchain establishes the tools necessary to protect the network from adversarial behavior, vulnerabilities, and disruptions. The ability to prevent supply chain disruptions is critical, as the damage can impact all supply chain partners and customers. Thus, supply chain partners must implement blockchain technology to leverage visible security benefits while operating in a secure information network.

Reliability

Blockchain technology will maintain a reliable and traceable network to reduce the risk of supply chain disruptions. For instance, the blockchain promotes reliability within the network through distributed ledgers, as users are accountable for maintaining transactions, thus enabling dependable records stored across multiple nodes (Maslova, 2018). In this instance, blockchain technology provides a reliable network of accountable transactions across multiple intersections to synchronize data. Therefore, data transactions are reliable, as no single point of failure will impact the network based on the design of storing records across multiple nodes. Additionally, the redundancy of data transactions available across the network will reduce the potential for supply chain disruptions, thus mitigating possible risks. Furthermore, the reliable blockchain network will increase confidence in data availability to support decision-making initiatives. For these reasons, supply chain partners must implement blockchain technology to achieve a reliable and traceable data network while maximizing redundancy to mitigate disruptions.

Immutability

The immutability of traceable data in the blockchain will assure supply chain partners while facilitating and supporting inquiries. For example, as supply chain partners cannot modify data transactions without consensus, the blockchain ensures the procurement process by easing audits and maintaining secure data records while offering comprehensive traceability (Lumineau et al., 2021). In this instance, blockchain technology ensures data is unchangeable, thus increasing confidence and trust in the data within the network. Additionally, since the information is permanent, supply chain partners will benefit from the ability to query historical transactions to support analytical initiatives. Furthermore, the inability to revise or reverse transactional records will provide consistency and clarity during audits. Ultimately, supply chain partners must implement blockchain technology to leverage the benefits of immutability while gaining long-term advantages of assurance throughout the network.

Visibility

To alleviate reputational risk, supply chain partners will benefit from blockchain technology's comprehensive data visibility and traceability. For example, socially responsible organizations can utilize blockchain technology to gain additional supply tier visibility among supply chain partners, thus mitigating reputational risks (Cole et al., 2019). In this instance, blockchain technology proves to be a valuable resource for organizations to use while overseeing the fulfillment of social responsibility initiatives. In addition, gaining visibility into second and third-tier suppliers will assure an organization of compliance while mitigating high reputational risks associated with unethical behavior and negative press. Therefore, supply chain partners must implement blockchain technology to achieve comprehensive data visibility while maximizing assurance to minimize reputational consequences.

Conclusion

In conclusion, blockchain technology proves beneficial for supply chain management. Specifically, blockchain technology establishes an innovative network that generates collaboration, coordination, transparency, and traceability in supply chain management. Thus, blockchain technology is a powerful resource for mitigating risks and gaining opportunities in supply chain management. As a result, supply chain organizations will benefit from implementing blockchain technology to promote strategic initiatives and achieve a competitive advantage. However, while beneficial, blockchain technology may be met with resistance during implementation, as innovative software may be a barrier for new users. For this reason, future research on blockchain technology should investigate the effects of implementation among new users.

REFERENCES

Bedin, A.R.C., Capretz, M., & Mir, S. (2021). Blockchain for collaborative businesses. *Mobile Networks and Applications, 26*(1), 277-284. **https://doi.org/10.1007/s11036-020-01649-6**

Bragadeesh, S.A., Umamakeswari, A., Varadarajan, V., Kommers, P., Piuri, V., & Subramaniyaswamy, V. (2020). Development of a reliable supply chain system using blockchain. *Journal of Intelligent and Fuzzy Systems, 39*(6), 8377-8387. **https://doi.org/10.3233/JIFS-189156**

Cole, R., Stevenson, M., & Aitken, J. (2019). Blockchain technology: Implications for operations and supply chain management. *Supply Chain Management: An International Journal, 24*(4), 469-483. **https://doi.org/10.1108/scm-09-2018-0309**

Ehsan, I., Khalid, M.I., Ricci, L., Iqbal, J., Alabrah, A., Ullah, S.S., & Alfakih, T.M. (2022). A conceptual model for blockchain-based agriculture food supply chain system. *Scientific Programming, 2022,* 1-15. **https://doi.org/10.1155/2022/7358354**

Lumineau, F., Wang, W., & Schilke, O. (2021). Blockchain governance—A new way of organizing collaborations? *Organization Science, 32*(2), 500-521. **https://doi.org/10.1287/orsc.2020.1379**

Madhani, P.M. (2021a). Enhancing supply chain capabilities with blockchain deployment: An RBV perspective. *IUP Journal of Business Strategy, 18*(4), 7-31. **https://web-s-ebscohost-com.athens.idm.oclc.org/ehost/detail/detail?vid=1&sid=c9d90ac5-9a3a-4be3-9cdb-61b35d7e7bce40redis&bdata=JnNpdGU9ZWhvc3QtbG12ZQ%3d%3d#db=buh&AN=155422606**

Madhani, P.M. (2021b). Supply chain transformation with blockchain deployment: Enhancing efficiency and effectiveness. *IUP Journal of Supply Chain Management, 18*(4), 7-32. **https://athens.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/supply-chain-transformation-with-blockchain/docview/2633005413/se-2?accountid=8411**

Maslova, N. (2018). Blockchain: Disruption and opportunity. *Strategic Finance, 100*(1), 24-29. **https://athens.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/blockchain-disruption-opportunity/docview/2199064220/se-2?accountid=8411**

Pardeshi, K. (2021). An overview of blockchain in supply chain management: benefits and issues. *IUP Journal of Supply Chain Management, 18*(3), 38-47. **https://search-ebscohost-com.athens.idm.oclc.org/login.aspx?direct-true&db-buh&AN=153131267&site=ehost-live**

Pournader, M., Shi, Y., Suering, S., & Koh, S.C.L. (2020). Blockchain applications in supply chains, transport and logistics: A systematic review of the literature. *International Journal of Production Research, 58*(7), 2063-2081. **https://doi.org/10.1080/00207543.2019.1650976**

Stoica, M., Ghilic-Micu, B., & Mircea, M. (2019). Restarting the information society based on blockchain technology. *Informatica Economica, 23*(3), 39-48. **https://doi.org/10.12948/ISSN14531305/23.3.2019.04**

Yiu, N.C.K. (2021). Toward blockchain-enabled supply chain anti-counterfeiting and traceability. *Future Internet, 13*(4), 86. **https://doi.org/10.3390/fi13040086**

Innovative Ways Used to Mitigate the Supply Shortage of Personal Protective Equipment during COVID-19 Pandemic

Vivian Ojiri
M.S. Global Logistics and Supply Chain Management Major

ABSTRACT

The SARS-CoV-2 (COVID-19) led to many supply disruptions of the global supply chain. These supply disruptions came from containment measures that included movement restrictions and the lockdown of every industry. The lockdown led to a severe shortage of supplies worldwide, and every industry had to find ways to combat the shortage. The healthcare industry was highly affected as the lockdown led to a mass shortage of Personal Protective Equipment (PPE): face masks, gloves, respirators, goggles, face shields, and gowns. Workers were in constant contact with highly infectious patients and needed protection to care for them. As more people got sick, the demand for PPE increased. The rising demand for PPE resulted in a mass shortage, since supply could not meet the demand due to the lockdown. Manufacturing more PPE is a process that requires time and labor, the latter which was not available due to the lockdown. Due to the rapid increase of sick patients, the health industry had to develop innovative ways to mitigate this shortage. This paper lists some of those ways.

Introduction

The Coronavirus (SARS-CoV-2), widely known as COVID-19, began its spread in the Chinese city of Wuhan in December of 2019 (Dullius et al., 2021). As it quickly spread, it became a pandemic. According to OPAS, a Pan-American Health Organization (2020, as cited in Dullius et al., 2021), "By the first week of August 2020, there were 18,614,177 cases of COVID-19 with 702,642 deaths in the American region." The emergence of the coronavirus in China greatly destabilized the world's supply chain, as China is a central hub for manufacturing and distribution worldwide. The world faced a shortage of raw materials, finished goods, and semi-finished goods, particularly medical supplies critically needed to attend to sick patients infected by the coronavirus. The shortage of supplies resulted from the lockdown measure implemented to help stop the spread of the virus, resulting in a restriction of people, transportation of goods, production halt, logistical constraints, and border closures (PwC, 2020). The pandemic exposed the constraints of the world's supply chain. The implementation of the lockdown resulted in a partial closure of the transportation sector, on which the global supply chain depends.

The fast spread of the virus caused increased cases of infected people, causing the healthcare system to be overwhelmed because few healthcare workers were willing to work over fears of the virus. According to Rebmann et al. (2021), "A study conducted by the American Nurses Association found that about 79% of nurses felt unsafe due to PPE shortages and the associated use of PPE" (p. 1). The increased cases of infected people resulted in an explosive demand for PPE. Healthcare workers risk getting infected and spreading the virus if they are not well protected. The widespread shortages of PPE during the pandemic have placed healthcare workers at risk and threatened their ability to care for their patients (Sinha et al., 2020). Items needed to protect healthcare workers and patients include face masks (N95, surgical and non-surgical), gloves, respirators, face shields, surgical scrubs, and air filters for respirators. According to Sinha et al. (2020), "Many PPE shortages reflect fragile international supply chains based on just-in-time manufacturing and lean inventories."

To help healthcare workers mitigate the supply shortages during the COVID-19 pandemic, the Center for Disease Control (CDC) developed strategies to improve PPE use. These strategies include removing all face masks from public areas (entrances, near elevators). It also involves extending the use of PPE until it is soiled instead of discarding after one use, restricting PPE for only healthcare providers, canceling elective and non-urgent procedures which require PPE, and prioritizing the use of PPE for specific activities (Center for Disease Control, 2020).

Despite the strategies put in place by the CDC to help PPE shortages, the healthcare sector still experienced massive shortages due to the overwhelming cases of infected people, lockdown, border closure, and production halt. The shortage of PPE supply forms the purpose of this paper, which is to list the innovative ways used to alleviate supply shortages of PPE during COVID-19.

Literature Review

Sterilize and Reuse

The supply shortage of PPE was causing a more significant problem for the healthcare sector. The shortage of PPE meant the unavailability of healthcare providers. With hospitals reaching a maximum capacity of infected patients, healthcare administrators had to decide to develop an innovative approach to mitigate the supply shortage of PPE. Healthcare facilities had to innovate ways to sterilize PPE using ethylene oxide, UV/gamma irradiation, Ozone, and alcohol (Livingston et al., 2020). Sterilizing meant healthcare providers would not discard PPE after one use. Most facilities had their staff reuse masks as many times as possible before issuing a new mask; about 16.8% of facilities required five reuses of masks, while 12.8% of facilities required only one reuse (Rebmann et al., 2021). The reuse of masks helped elevate the worry of supply shortage.

Recover

The increasing number of deaths and infected people led to a lockdown and cancellation of elective and non-urgent procedures. While the world was on lockdown, the hospitals were beyond capacity with severely sick patients who needed care. The demand for PPE continued to rise, and healthcare providers had to resort to innovative ways to mitigate PPE shortage:

reclaiming unused PPE from non-urgent healthcare facilities like plastic surgeons, dentists, dermatologists, and opticians. They also recovered from non-healthcare sectors like farmers, construction workers, schools, and veterinary hospitals. Healthcare workers individually had to purchase their PPEs from the communities (Livingston et al., 2020).

Reprocess Materials

The pandemic caused the healthcare sector to take drastic measures in providing PPE for healthcare workers. The implications of PPE shortages will mean the continuous spread of the virus between infected patients and healthcare workers, resulting in a mass shortage of healthcare workers. To combat the issue, according to Krause, et al. (2021), "3D printers and laser cutters located across a network of more than 500 homes, small businesses, public schools, libraries, and university labs were used to produce face shields which served the purpose of PPE." The most common 3D printed PPEs were face shields, ear savers, stethoscopes, and masks (Daud et al., 2021). 3D printing provided a faster production of these PPEs and the ability for those PPEs to be tailored according to the demands of the healthcare worker's needs. Welders were engaged in PPE production. Military-grade gas masks, motorcycle helmets, visors, plastic raincoats, and scuba materials were all deployed as PPE (Livingston et al., 2020).

Nontraditional Supply Creation

Prior to the pandemic, China was the world's largest manufacturer of PPE and was responsible for half the world's supply of surgical masks and clinical gowns (Burki, 2020). The supply of PPE was known to be disrupted yearly by the celebration of the Chinese New Year, resulting in a production halt and the closure of all factories for 10-14 days (Burki, 2020). Unfortunately, the 2020 Chinese New Year celebration coincided with the pandemic, resulting in a complete shortage of PPE production and supply. Due to the supply constraints caused by the pandemic, it became apparent that the healthcare sector needed help with PPE supply and would have to source for this help locally. They had to develop creative ways to protect themselves while caring for infected patients. One of these ways was to look to the community and permit the procurement of nontraditional suppliers who became innovative with sewing machines and regular household items. These nontraditional suppliers created face masks and gowns from regular fabrics. Coffee filters and HVAC filters served the purpose of air filters for these fabric-sewn masks (Livingston et al., 2020). Another nontraditional supply creation was to use regular household plastic water bottles and Ziploc bags as PPEs supplied by the community.

Use of Automated Services

The pandemic illustrated the importance of delivery without contact. Self-driving robots enabled the on-time delivery of medications to sick patients without being in direct contact. Automated vehicles transported test kits and moved pieces of equipment within the hospital. Automated guided vehicles (AGVs) used during the pandemic ensured delivery efficiency and helped keep front-line healthcare providers safe (Livingston et al., 2020).

Maximizing the Use of Technology

The need to combat the supply shortage of PPE drove the healthcare system to use technology to provide efficient services to patients without contact. Access to mobile devices, computers, and telemedicine has now changed the view of physicals done by physicians. By implementing technology, healthcare providers can monitor their patients and reduce the risk of contamination and the spread of the virus, thereby reducing PPE use (Baucher et al., 2020). The healthcare sector also saw increased use of the Industrial Internet of Things (IIoT), an innovation that shares the inventory information of PPE to factories.

Categorize Patients According to Risk

The increasing number of infected patients during the pandemic required an increase in the number of healthcare providers needed. With the supply shortage of PPE, it was evident that some patients would be left without individual care. Medical providers had to develop innovative ways to group these patients according to risk factors to reduce PPE use. Patients who tested negative and were categorized as low risk were grouped and cared for without PPE. The high-risk patients benefited from this joint innovation as well. Healthcare providers developed ingenious ways to use one ventilator on two patients (Morales-Contreras et al., 2021). This joint innovation helped mitigate the supply shortage of PPE by being able to multiply a single PPE.

Tailor Staffing

When the demand for PPE became high, the healthcare sector shifted from a supply strategy focused on cost issues before the pandemic to a focus on availability and product quality. The emergence of COVID-19 triggered this shift, resulting in several innovations, one of which was tailoring down staff. Once the government canceled non-urgent and elective procedures because of the PPE supply shortage, it became necessary to reduce non-healthcare providers in the hospital. Students and hospital trainees who were not directly involved with patient care were reduced (CDC, 2021). Reduction of students and hospital trainees also helped reduce the amount of PPE required to run the hospital.

Conclusion

In conclusion, the COVID-19 pandemic is a typical example of a black swan event (an unpredictable event that is beyond what is normally expected of a situation and has potentially severe consequences). Black swan events are characterized by their extreme rarity, severe impact, and the widespread insistence they were obvious in hindsight. The unpredictable nature of the pandemic, added to a lack of planning, had significant consequences which put the world in disarray. The rise in the fluctuation of supply and demand tested the ability of every manufacturer. Every industry felt the pain of the pandemic. Every supply chain sector was affected. The implementation of the lockdown limited the manufacturing of several supplies, including PPE. The transportation sector was almost non-existent, international borders were closed, and local borders were very careful in admitting interstate travelers. The healthcare sector was, arguably, the most impacted as it heavily relied on international manufacturers for medical supplies.

Most importantly, the healthcare sector relied on international factories to supply PPE. The health industry had limited local PPE suppliers, which complicated the issue. Innovative strategies had to be employed to mitigate the PPE supply shortage. Some of these innovations included sterilize

and reuse, recover, reprocess of materials, creation of non-traditional supply, use of automated services, maximizing the use of technology, categorizing patients according to risk, and tailor staffing. However, some of these innovations could only serve in the short term and under pandemic emergency basis, since they go against medical guidelines. Therefore, a better innovation strategy should address how to improve the lines of communication for better inventory management of PPE. It will also be essential to look domestically for suppliers, encouraging small, local businesses instead of relying heavily on international manufacturers. Ultimately, the healthcare sector needs to plan and be well prepared for unforeseen events like the pandemic, which can be done by incorporating high-demand planning that can forecast and predict an increased demand for PPE and medical supplies during a pandemic.

REFERENCES

Bauchner, H., Fontanarosa, P.B., & Livingston, E.H. (2020). Conserving supply of personal protective equipment—A call for ideas. *JAMA, 323*(1), 1911. **doi:10.1001/jama.2020.4770**

Burki, T. (2020). Global shortage of personal protective equipment. *The Lancet. Infectious Diseases, 20*(7), 785-786. **https://doi.org/10.1016/S1473-3099(20)30501-6**

Center for Disease Control. (2020). *Optimizing ppe supplies.* **https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/index.html**

Daud, A., Hussein, I.M., Zhang, P.C., Ahmed, Y., Trac, J., Vujovic, N., Rizvi, S.F., & Kuzyk, P.R. (2021). 3D-printed personal protective face shields during the COVID-19 pandemic: A survey of Canadian frontline workers. *Cureus, 13*(9), e18141. **https://doi.org/10.7759/cureus.18141**

Dullius, W.R., Scortegagna, S.A., & McCleary, L. (2021). Coping strategies in health professionals facing Covid-19: Systematic review. *Psicologia: Teoria e Prática, 23* (1), 1-20. **doi:10.5935/1980-6906/ePTPC1913976**

Krause, M., Henderson, A., Griner, D., Rissland, O.S., Beard, J., Bartels, K. (2021). A statewide voluntary movement addressing the shortage of medical supplies during the COVID-19 pandemic. *American Journal of Public Health, 111*(9), 1595-1599.

Livingston, E., Desai, A., & Berkwits, M. (2020). Sourcing personal protective equipment during the COVID-19 pandemic. *JAMA, 323*(19), 1912-1914. **doi:10.1001/jama.2020.5317**

Morales-Contreras, M.F., Leporati, M., & Fratocchi, L. (2021). The impact of COVID-19 on supply decision-makers: The case of personal protective equipment in Spanish hospitals. *BMC Health Services Research, 21* (1), 1170. **https://doi.org/10.1186/s12913-021-07202-9**

PwC. (2020). *Impacts of COVID-19 on the supply chain industry.* Price Water House Coopers. Retrieved November 17, 2021, from **https://www.pwc.com/ng/en/assets/pdf/impact-of-covid19-the-supply-chain-industry.pdf**

Rebmann, T., Alvino, R.T., & Holdsworth, J.E. (2021). Availability and crisis standards of care for personal protective equipment during fall 2020 of the COVID-19 pandemic: A national study by the APIC COVID-19 task force. *American Journal of Infection Control, 49*(6), 657-662. **https://doi.org/10.1016/j.ajic.2021.03.015**

Sinha, M.S., Bourgeois, F.T., & Sorger, P.K. (2020). Personal protective equipment for COVID-19: Distributed fabrication and additive manufacturing. *American Journal of Public Health, 110*(8), 1162-1164.

Contributors

Jacqueline Allison, originally from West Islip, NY, is a current resident of Huntsville, AL. She has over a decade of experience in the defense industry, supporting operations and supply chain management roles across various military programs and aircraft platforms. Jacqueline holds a BSBA in Airport Management and a BSBA in Logistics Management from Middle Georgia State University and is pursuing a Master's in Global Logistics and Supply Chain Management at Athens State University. She enjoys spending time with her husband, Eric, and three brindle rescue dogs, Kava, Bruin, and Chino. Her hobbies include advocating for rescue dogs, photography, traveling, running, hiking, and mountain biking.

Jacob Bauch is from Madison, Alabama. He earned his Bachelor of Science degree in Supply Chain Management from Auburn University. Jacob is finishing up his Master of Science in Global Logistics and Supply Chain Management from Athens State University. Jacob currently works as a Material Planning Controller at the United Launch Alliance in Decatur, Alabama. In his free time, he enjoys spending time with family and friends, being outdoors, and playing or watching sports. Upon completion of his Master's degree, Jacob hopes to build on his career in the supply chain industry and place into practice the knowledge he has garnered.

Dominique Clerge is a native from Petion-Ville, Haiti, who immigrated to America in December 2009. He is currently living in Fayetteville, North Carolina. Mr. Clerge is an active-duty, U.S. Army service member stationed at Fort Bragg, NC. He is currently serving as a Battalion senior logistics advisor to the Battalion Commander under the 1st Special Forces Command (Airborne). Mr. Clerge is a graduate in Logistics and Transportation Management from American Public University and is pursuing a Masters degree in Logistics and Supply Chain Management at Athens State University with a projected graduation date of December 2022. Mr. Clerge's hobbies consist of reading medieval fiction books (*The Alchemist* by Paolo Coelho is my favorite book) and world news articles, gardening, taking road trips, and spending time with family.

Keatha Davenport is pursuing a Master of Science in Global Logistics and Supply Chain Management at Athens State University. She received her Bachelor of Science in Physics from Grambling State University. Keatha is currently employed by Aegis Aerospace, Inc. in Houston, Texas, and works as a Logistics Coordinator in the Space Food Systems Laboratory at NASA Johnson Space Center. During her spare time, she enjoys spending time with her husband and three children.

David Gatlin is a lifelong resident of Toney, Alabama. He is currently employed at ATI Specialty Alloys & Components as the Senior Leader of Supply Chain and Logistics. He received his Business Administration degree at Faulkner University and is finishing his M.S. in Global Logistics and Supply Chain Management at Athens State University. He is a member of the National Society of Leadership and Success (NSLS). He is a deacon at Pineview Baptist Church where he serves on the school board of Pineview Christian Academy. He is also a Gideon and serves as the Area Director for the Gideons International for the Huntsville area.

Dr. Cynthia Lovelace serves as an Assistant Professor of Logistics within the College of Business at Athens State University, where she teaches both undergraduate and graduate courses in logistics. She has over 20 years teaching experience at both the undergraduate and graduate levels in business and engineering, as well as corporate training and consulting experience provided to a wide variety of industry groups through her consulting firm. Her research has focused on process capability analysis, and her current research efforts are focused on the application of these techniques to current supply chain metrics. She has served as a Certified Quality Engineer through ASQ, and is currently a member of APICS and the National Contract Management Association. She is the co-

Contributors

author of *Process Capability Indices in Theory and Practice* with Dr. Samuel Kotz.

Bobby Morris is currently attending Athens State University for a Bachelor's degree in Business Management with a minor in Healthcare Management. He is currently employed as the Executive Director of Operations at Cullman Regional Medical Center. Bobby is a Certified Healthcare Facility Manager with over 20 years of experience in the healthcare field covering the environment of care, safety, construction, security, fire safety, medical equipment, emergency management training, among other daily operational needs of the hospital. In his free time, Bobby enjoys spending time with his family and traveling to new places.

Joy Oettel is an Instructional Designer and senior at Athens State University. After 18 years as an educator and online curriculum writer, she is pursuing a degree in Technical Education with a concentration in Instructional Design. As a staff member of Athens Teaching and Learning Innovation Services, Joy designs online courses using the ActiveFlex model. She received her B.A. in English from Auburn University and her M.Ed. from the University of Montevallo. She resides in Decatur where she enjoys working as a ceramic artist and hiking with her husband and two daughters.

Vivian Ojiri is one of the managers at Rapid Response Urgent Care. She currently lives in Texas and is pursuing a Master of Science degree in Global Logistics and Supply Chain Management at Athens State University. Vivian holds a Bachelor of Science degree in Sociology and Anthropology and two Associate of Science degrees. She is a wife and mom of two and prides herself on the morals and values instilled in her by her parents, who are originally from West Africa. Vivian is a Christian who believes that with God, all things are possible. She is an avid gardener and enjoys dancing and watching good movies.

Payton Andrews Roberts is from Huntsville, Alabama. She graduated Summa Cum Laude with a Bachelor of Science in Behavioral Science and two minors in Human Development and Business Administration. She recently married and is enjoying life as a newlywed. Payton and her husband plan on going into youth ministry in the near future and working with students to help them walk through life. She enjoys spending time with her family and friends, being outside, and reading.

Jeannia Terry is a resident of Trinity, Alabama. She is employed as a Quality Professional at Nucor Steel in Decatur, Alabama. She is currently pursuing a Bachelor of Science in Management of Technology with a minor in Accounting. Her hobbies include anything fitness, reading, serving at her local church, and spending time with her family.

Business Insights

A College of Business Research Journal

Business Insights: A College of Business Research Journal is an annual publication of the College of Business at Athens State University. Athens State University's College of Business is nationally accredited by Accreditation Council for Business Schools and Programs (ACBSP).

The mission of the College of Business is to offer programs of study to students that will prepare them for positions in business, finance, or government; enhance the professional development of those already employed; and provide an academic framework for graduate study leading to professional positions. The purpose of the College of Business is to provide quality education for all students, teaching them to think critically, to use technology effectively, to be effective leaders, decision makers, and communicators; to maintain ethical standards, and to understand the global economy.

Contact Us

Give us a call for more information about this publication or Athens State University.

Athens State University
300 North Beaty Street
Athens, AL 35611

(256) 216-5352

Molly.Pepper@athens.edu

Visit us on the web at www.athens.edu/business/