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Strategies to Minimize the Bullwhip Effect in the Electronic Component Supply Chain

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MS, University of Wisconsin, Madison, 1997

BS, Alabama A&M University, 1995

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

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Abstract

Supply chain leaders in the information technology industry face challenges regarding their ability to mitigate amplified demand and supply variability in a supply chain network--the bullwhip effect--and reduce adverse implications on their component supply chain networks. The purpose of this multiple case study was to explore the strategies supply chain leaders in the United States used to reduce the bullwhip effect. Bullwhip effect theory served as the conceptual framework. Participants in the study were 5 purposefully selected supply chain leaders in the state of Texas who successfully implemented strategies to reduce the bullwhip effect on their networks. Data were collected from semistructured interviews and analysis of documents from the participants' websites. The data were analyzed using the 5 data analysis steps consistent with Yin's approach: collection, stratification, reassembly, interpretation, and conclusion. Four themes emerged from data analysis: (a) collaboration strategy, (b) communication strategy, (c) component shortage reduction strategy, and (d) resource management strategy. Supply chain leaders might use the findings of this study to reduce the bullwhip effect within their networks and improve their profitability. The implications for positive social change include the potential for leaders to improve environmental sustainability by using effective supply chain strategies to reduce the accumulation of excess inventories, reduce transportation fuel usage, and lessen the consumption of natural resources.

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Dedication

I dedicate this study to my sons who are the source of my energy, support, and happiness. My God is with us (Immanuel, AKA Kelechi: KC), Will of God (Angel, AKA Uchechi: UC), and nothing is greater than God (Blessing, AKA Ginikachi: GC); thank you for your unconditional love and unwavering support. Together, we agreed that we could, and together, we did it! To God be all the Glory, now and always, Amen! KC, the times you cooked, served me food in my study room, took care of your brothers while I attended my first doctoral residence, and the back massages with kisses helped in ways you might never understand. UC, I am grateful for those times you woke up early to take your brother to school so that I could get a few more minutes of sleep before I went to work; thank you for entertaining your brother so that I could study. The times you called to check on my health and ensure that I was doing well with my stress management made the world of difference and motivated me in more ways than I can put in writing. My precious GC, you were there for me every step of the way. Thank you, son, for the hugs, kisses, and cuddles; more importantly, thank you for taking charge of your schoolwork, soccer training, and Kumon worksheets. Together, we did it!

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Section 1: Foundation of the Study

A supply chain is an organized network comprised of multiple internal and external business entities (Joseph, 2014). Variations in consumer demand, unpredictable component availability, fierce competition, and market stagnation create tremendous challenges for supply chain leaders (Milkovich, 2016). Li, Wu, Holsapple, and Goldsby (2017) noted that supply chain leaders spend substantial financial sums to expedite production activities to ensure component availability and reduce the *bullwhip effect*, a term coined by Forrester (1961) to refer to the amplified demand variability in the supply chain. Business leaders use the supply chain to meet consumer demand and maximize operational performance (Chen, 2016; Fischer & Montalbano, 2014). Leaders often aim to leverage the supply chain through offshoring and outsourcing to sustain their value proposition, outperform their competitors, and achieve consumer satisfaction (Schoemaker & Tetlock, 2017). Although some leaders have succeeded in using offshoring and outsourcing as a strategy, an unintended consequence is an amplification of the demand variability that creates supply excesses or shortages (Steven & Brito, 2016). This variability may foster unpredictability in production components that compromises business profits.

Background of the Problem

The offshoring and outsourcing of information technology (IT) manufacturing and electronic component sourcing to emerging markets poses challenges for some North American multiechelon supply chain organizations (Kumar, Himes, & Kritzer, 2014).

Offshoring and outsourcing initiatives can trigger demand and supply disparity causing operational inefficiencies across the supply chain network (Taylor, 2016). One of the signs of operational inefficiencies is the bullwhip effect, an effect that was coined by Forrester in 1961. The amplification of the bullwhip effect occurs from a communication lag among network partners, consumer demand fluctuations, and unpredictable supply availability (Steven & Brito, 2016). The bullwhip phenomenon forces practitioners to operate in a reactive mood (Bruccoleri, Cannella, & La Porta, 2014). Manufacturers worry about supply availability while suppliers fear demand instability. Concurrently, supply chain organization leaders seek innovative approaches to reduce operational cost and achieve sustained competitive advantage and customer satisfaction (Grewal, Roggeveen, Sisodia, & Nordfält, 2017). The push-pull communication model amplifies the bullwhip effect within a multiechelon supply chain environment. The implication is that the bullwhip effect affects not only an organization's economic performance, but also its social and environmental sustainability because of inventory variability, human impact, product quality, and customer satisfaction (Asgary & Li, 2016; Grewal et al., 2017). Isaksson and Seifert (2016) recommended additional research to gain additional knowledge of the full implication of bullwhip effect on a multiechelon supply chain. Similarly, Ekinci and Baykasoglu (2016) suggested further research to gain a full understanding of the contribution of the bullwhip effect on multiechelon supply chain complexities. I conducted this study to address this gap in research.

Problem Statement

Demand and supply variability across multiechelon supply chain networks amplifies the bullwhip effect (Taylor, 2016). Approximately 67% of businesses with multiechelon supply chain networks experience the bullwhip effect, resulting in profitability reductions of 10%-30% (Narayanan & Moritz, 2015). The general business problem was that the bullwhip effect negatively affects the predictability of electronic component availability, causing decreased profitability. The specific business problem was that some IT supply chain leaders lack strategies to reduce the bullwhip effect on their supply chain network.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that some IT supply chain leaders use to reduce the bullwhip effect on their supply chain network. The targeted population consisted of 15 supply chain leaders of five IT companies located in Houston, Texas, who have successfully implemented strategies to reduce the bullwhip effect on their supply chain network. The implication for social change includes improving environmental sustainability through reductions in excess and obsolete inventories and the consumption of storage-related resources, transportation fuels, and other natural resources.

Nature of the Study

The three research methods include qualitative, quantitative, and mixed (Felix Octavio, 2016). I selected the qualitative method because it enabled me to pose open-

ended questions to participants. Qualitative researchers use open-ended questions to discover what is occurring or what has occurred (Parry, Brax, Maull, & Ng, 2016). In contrast, quantitative researchers who collect data via interviews use closed-ended questions to gather data to test hypotheses about the relationships or differences among variables (Tse, Matthews, Hua Tan, Sato, & Pongpanich, 2016). Mixed-methods researchers include both a qualitative element and quantitative element to address research questions (Felix Octavio, 2016). I did not test hypotheses for this study; therefore, the qualitative method was the appropriate choice.

I considered four research designs: (a) phenomenology, (b) ethnography, (c) narrative inquiry, and (d) case study. According to Matua (2015), phenomenological researchers describe participants' experiences and interpretation of the event. The phenomenological design was not appropriate for this study because I did not explore the participants' lived experiences of a phenomenon. Norman and Verganti (2014) postulated that ethnographic researchers study a culture of a group to understand how culture affects peoples' behavior and values. The ethnographic design was not appropriate for this study because I did not study a group's culture. Shedrow (2017) stated that narrative inquirers study the life experiences of individuals through their stories. The narrative inquiry was not appropriate for this study because I did not study individuals' life experiences through their stories. According to Yin (2017), researchers use case studies to explore phenomena and gather data from a natural setting where the phenomena occur. I explored existing strategies supply chain leaders have used in their organizational setting to reduce

the bullwhip effect; therefore, a case study was the appropriate research design for this study.

Research Questions

What strategies do some IT supply chain leaders use to reduce the bullwhip effect on their electronic component supply chain?

Interview Questions

1. What effect did the bullwhip phenomenon have on electronic component sourcing strategy?
2. What strategies did you use to reduce the bullwhip effect in your supply chain?
3. What strategy did you use to manage electronic component shortage escalations?
4. What strategy did you use to manage excess electronic component inventory?
5. What strategy did you use to manage aged or obsolete electronic components?
6. What effect did the electronic component shortages have on delivery strategies?
7. What barriers did you encounter to implementing the strategies for reducing the bullwhip effect on your supply chain?
8. How did you address the barriers to implementing the strategies for reducing the bullwhip effect on your supply chain?
9. How did you assess the effectiveness of your strategies for reducing the bullwhip effect on you supply chain?
10. What additional information regarding strategies to minimize the bullwhip effect on your supply chain would you like to add?

Conceptual Framework

The bullwhip effect theory, developed by Forrester (1961), was the guiding conceptual framework for this study. Lee, Padmanabhan, and Whang (1997) later extended the work of Forrester by using the bullwhip effect theory to evaluate the uncertainty in lead times as order data propagates between upstream and downstream process nodes. Supply chain leaders use the bullwhip effect theory to explain supply chain processes based on the premise that an efficient supply chain strategy dampens the bullwhip effect, reducing excess and obsolesce inventory and improving supply chain operational performance (Forrester, 1961). The key propositions underlying the theory are (a) component sourcing strategy, (b) component lead times, (c) component shortage escalation, (d) excess inventory management, and (e) component health evaluation (Isaksson & Seifert, 2016). Punniyamoorthy, Thamaraiselvan, and Manikandan (2013) successfully employed the bullwhip effect theory to identify the key strategies to mitigating supply chain process risks. I used the theory to explore strategies that some IT supply chain leaders use to reduce the bullwhip effect on their supply chain network. I expected that early identification of electronic component sourcing risk factors could be beneficial to supply chain leaders in determining if alternative sourcing strategies could be more efficient to reduce the amplification of bullwhip effect.

Operational Definitions

The supply chain phrases and concepts used in this study appear in the academic and business literature. The most relevant phrases and concepts for this study follow:

Bullwhip effect: The bullwhip effect refers to the demand and supply variability in a supply chain environment that results in operational inefficiencies (Asgary & Li, 2016).

Supply chain: The supply chain is a network consisting of different business entities that form an alliance based on a shared vision of using economies of scale to produce high quality and low-cost products that meet customer demand, reduce operational cost, generate revenue and profit margin, and achieve business growth (Trang, 2016).

Supply chain collaboration: Supply chain collaboration is the synchronization of the network members' process strategies to meet the fluctuating customer demands (Yilmaz, Çemberci, & Uca, 2016).

Supply chain innovation: Supply chain innovation is the use of synergy to transform business processes (Zhang, 2015). Pathak (2016) stated that the need to dampen order fluctuations to meet customer demand in a timely manner requires both vertical and horizontal innovative strategies

Supply chain management: Supply chain management is the system thinking approach that organizational leaders employ to respond to business challenges, sustain an organization's current market position, and compete in new market opportunities (Al-Zu'bi, 2016).

Supply chain operation: Supply chain operation is the operational strategies that members of the supply chain network employ to maximize customer value and achieve a competitive advantage (Foerstl, Azadegan, Leppelt, & Hartmann, 2015).

Supply chain sustainability drivers: Supply chain sustainability drivers are factors such as return on the investment, sales, revenue increase, cash flow, and market position that enable an organization to sustain its business growth (Maletič, Maletič, Dahlgaard, Dahlgaard-Park, & Gomiscek, 2015).

Sustainability factors: Sustainability factors are the environmental, social, economic, and political factors that possess the capacity to influence consumer demand priorities (Metz, Burek, Hultgren, Kogan, & Schwartz, 2016).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are expectations that a researcher assumes to be true but cannot verify; thus, assumptions are out of the researcher's control (Dean, 2014). I assumed that the participants, all of whom were supply chain leaders of IT companies, provided honest and complete answers to the interview questions. In addition, I assumed that the texts I reviewed -- publicly available company documents regarding the strategies used by the leaders to reduce the bullwhip effect -- were up-to-date, accurate, and complete.

Limitations

Limitations are the constraints and weaknesses within a study that are out of the researcher's control (Middleton, 2016). A limitation of this study was that the interview data I collected reflected the experience and opinions of leaders in five IT organizations and not the views of the broader population of IT leaders. The restriction of the sample population to Houston, Texas, was another limitation. The limited scope of the study

reduces the transferability of the findings to other geographic settings or organizations. A final limitation was that I relied on the honesty of potential participants as well as the accuracy of supporting documentation to develop emergent themes.

Delimitations

Delimitations are the boundaries of the research study (Rusly, Sun, & Corner, 2015). The boundaries for this doctoral study were my focus on exploring supply chain leaders' experience in reducing the bullwhip effect in the supply chain. Additionally, electronic components were a focus of this study. A delimitation was that I limited the participants to supply chain leaders of five IT companies. The geographic region of Houston, Texas, was also a delimitation. Another delimitation was that answering the research question required focusing on strategies leaders used to minimize the bullwhip effect in the electronic component supply chain; therefore, I did not address other bullwhip issues that might affect leaders in the IT industry.

Significance of the Study

This study is significant because of its potential to provide supply chain leaders with strategies to reduce the bullwhip effect in the electronic component supply chain. According to Asgary and Li (2016), supply chain disruption is one of the leading challenges facing supply chain leaders. The additional potential value of this study lies in reducing the adverse consequences of the bullwhip effect regarding customer service, operational performance, revenue generation, and profit margin.

Contribution to Business Practice

Supply chain leaders face the challenge of helping grow the organizational business. The outcome of this study might provide supply chain leaders with efficient component sourcing strategies to improve their business practices through financial, operational, and cultural change and the addressing of end-customer perspectives. Providing supply chain leaders with effective sourcing strategy might help to lessen shortages escalations as well as reduce the organization's annual spending on excess component inventory. Implementing successful strategies could also lead to improved employee work efficiency resulting in increased partner engagement with integrated tools and processes.

Implications for Social Change

The potential implications for social change are improving environmental sustainability through reductions in excess and obsolete inventories, decreases in consumption of storage-related resources, reduction in transportation fuels usage, and conservation of other natural resources. Global warming awareness is the key driver that influences contemporary consumer demand priorities (Hsu, Tan, & Mohamad Zailani, 2016). According to Maletič et al. (2015), sustainability drives innovation and competitive advantage. Therefore, the integration of environmental and social capabilities in electronic component sourcing strategies could strengthen supply chain organizations' capacity to create sustainable competitive advantage. Maletič et al. affirmed that supply chain organizations with integrated sustainability initiatives and system level strategies

gain better exposure to new opportunities. Consumers use demand-driven innovation and product development opportunities to patronize supply chain organizations that have demonstrated socially responsible sustainable business practices (Maletič et al., 2015). Therefore, by removing waste from component sourcing strategies and leveraging the sustainability initiatives of supply chain network partners, organizations can improve their economies of scale while conserving natural resources.

A Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to explore strategies that some IT supply chain leaders used to reduce the bullwhip effect on their supply chain network. In the literature review, I provide readers with a foundation for understanding my exploration of these leaders' strategies. I conducted this literature review to assess the existing body of knowledge on the bullwhip effect and determine the extent to which researchers have studied the effect. I used the literature review process to identify and familiarize myself with the leading researchers on the bullwhip effect and their underlying research questions, methodologies, and findings. Upon completion of the literature review, I identified other areas of the bullwhip effect that needed further research.

Literature Search Strategy

I used multiple strategies to search for supporting literature for this study. Through the Walden University Library, I accessed databases such as Academic Search Complete, Business Source Complete, and ProQuest Science Journals. I also used SAGE

Journals, ABI/INFORM Collection, ProQuest Dissertation and Thesis, EBSCO Complete, and Emerald Management Journals databases and the Google Scholar search engine to locate scholarly, peer-reviewed articles on the bullwhip effect. The keywords I used to search for relevant literature were *bullwhip effect theory*, *supply chain theories*, *electronic component sourcing*, *off-shore sourcing*, *outsourcing theories*, *excess inventory*, *amplification in the supply chain*, *just-in-time inventory issues*, and *supply chain operation inefficiencies*.

Organization of the Literature Review

To enable a comprehensive understanding of the bullwhip effect phenomenon, I used five themes to organize the literature review content. The first theme was the bullwhip effect theory followed by complementary and alternative theories. The second theme was the business application of the bullwhip effect theories. The third theme was the global supply chain management. The fourth theme was the IT economy. The fifth theme was the environmental effect on global supply chain sustainability.

Reference Source Analysis

In this literature review, I provide the foundation for my exploration of the bullwhip effect in the component supply chain within the IT industry. I reviewed 431 references, which included qualitative, mixed-methods, and quantitative research studies; dissertations; government websites; and seminal books. Of the 431 references used, 422 (98%) were peer reviewed. Sources published from 2014-2018 make up 423 (98%) of the sources used. The literature review portion of the study consists of 178 unique references.

Of the 178 resources used in the literature review, 166 were peer-reviewed and published from 2014-2018. The remaining peer-reviewed, nonpeer-reviewed articles, government websites, and seminal books account for 24 sources.

Bullwhip Effect Theory

The bullwhip effect theory was the conceptual framework for this study. Forrester (1961) originated the bullwhip effect theory while analyzing inventory replenishments in a multiechelon supply chain network. Forrester contended that demand and supply variability are factors in operational disruptions. Reinforcing Forrester's viewpoint, Vestrum (2016) argued that lack of resource collaboration within the supply chain network is the cause of the observed operational disruptions. In disagreement with Forrester and Vestrum, Foerstl et al. (2015) and Marshall, McCarthy, McGrath, and Claudy (2015) claimed that the factors driving disruption are inefficient operational processes. An inefficient operation process can trigger demand and supply variability (Marshall et al., 2015). Bounou, Barkany, and Biyaali (2017) noted that the adverse economic consequences of inefficient operations are the reductions in revenue generation that stems from component shortages and production waste in the form of idle employees. In addition, demand and supply variability have adverse effects regarding on-time delivery of customer orders, according to Taylor (2016).

The concept of the bullwhip effect theory has continued to receive significant attention by several researchers. Chatterjee, Mateen, and Chakraborty (2015) used the bullwhip effect theory to evaluate the effect of demand and supply variability on supply

chain performance. Desai, Desai, and Ojode (2015) noted that the bullwhip effect has the potential to disrupt supply chain processes, thereby forcing leaders to manage operational crisis reactively.

Wolf (2014) cautioned that reactive management of supply chain disruptions could result in high resources utilization that might adversely affect an organization's social and environmental sustainability. Wolf's view is in contrast to that of Pfeffer and Salancik (1978), who asserted that organizational leaders use their resources to drive sustained business performance. A favorable business performance influences the organization's social and environmental sustainability, according to Pfeffer and Salancik. Shaffer and Dalton (2014) argued that other factors such as lack of understanding of each network partner's business needs are the cause of operational disruption that might amplify the bullwhip effect. At the same time, according to Taylor (2016), the bullwhip effect adds a high level of operational complexities resulting in (a) the use of inefficient processes to manage supply chain activities, (b) excess inventory spending, (c) obsolescence, and (d) increased operational costs.

Supply chain leaders face challenges in managing the complexities of demand, supply, and logistics in a multiechelon supply network (de Freitas Almeida, Conceição, Pinto, de Camargo, & de Miranda Júnior, 2018). Lee et al. (1997) and Taylor showed that the evidence of the bullwhip effect is a lag in information flow between downstream and upstream supply chain network as shown in Figure 1. Jaipuria and Mahapatra (2015) found that an amplification of the bullwhip effect driven by a communication lag could

negatively affect supply chain's performance measures, such as raw materials, finished goods inventory, work in progress, and material availabilities.

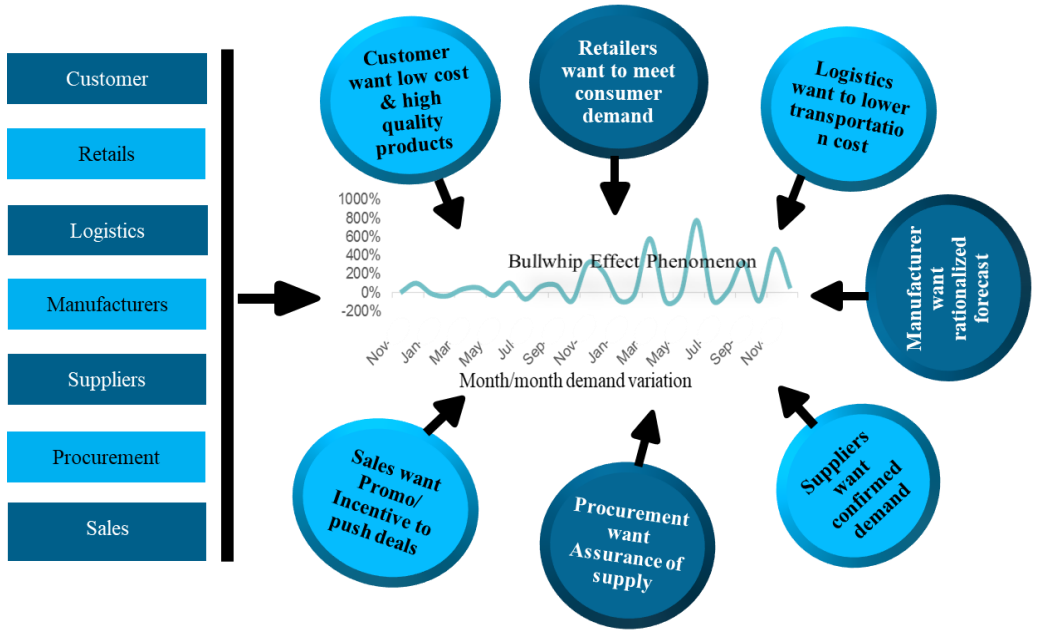

Figure 1. Time series showing how demands variability can trigger bullwhip effect in multiechelon supply chain network (Lee et al., 1997; Taylor, 2016).

The communication delay between network partners creates uncertainty in supply availability, which directly affects order shipment schedules (Forrester, 1961). Mamavi, Nagati, Pache, and Wehrle (2015) argued that supply chain operational disruptions are a consequence of unintegrated operation's processes, especially in an environment where network partners are operating under different sets of priorities. Nagashima, Wehrle, Kerbache, and Lassagne (2015) contended that inefficient collaboration and communication strategies are responsible for creating supply chain complexities. An

inefficient operational strategy can result in unanticipated disruption and increased operational cost (Nagashima et al., 2015). Flynn, Koufteros, and Lu (2016) asserted that if leaders resort to using a reactive approach to manage supply chain strategies, the adverse implication could lead to bullwhip effect events causing substantial operational wastes. Supply chain leaders should implement effective strategies to mitigate the triggers of operational disruptions within the network to reduce bullwhip effect in the electronic component supply chain (Uca, Çemberci, Civelek, & Yilmaz, 2017). Taylor (2016) contended that the observed bullwhip effect stems from a disruption in information flow and uncertainty in supply availability to meet customer orders.

Foerstl et al. (2015) acknowledged that the observed bullwhip effect relates to capacity planning variance, inventory obsolescence, schedule production fluctuations, and hidden process costs. Asgary and Li (2016) noted that the bullwhip effect could result in a change in the mode of transportations, poor customer service resulting in lost revenue, and reduced supply chain performance. Mandal, Bhattacharya, Korasiga, and Sarathy (2017), in agreement with Asgary and Li, commented that component shortage escalations trigger events that directly affect supply chain logistics, often resulting in a change of transportation mode, higher cost, and lower customer satisfaction. Alternatively, Wolf (2014) postulated that proactive integration of network partners' expectations to an organization's system-level strategies might result in partner longevity that correlates with a reduced bullwhip effect, sustained organizational performance, and customer satisfaction. Zhang and Xi-Gang (2016) suggested the application of reuse and

remanufacturing of electronic products content to reduce bullwhip effect and improve end-to-end supply chain operational performance. Caridi, Moretto, Perego, and Tumino (2014) agreed with Zhang and Xi-Gang by demonstrating that improved supply chain visibility is a means for supply chain leaders to reduce the bullwhip effect in supply chain processes.

Unlike the bullwhip effect theory, resource dependence theorists argued that the lack of leaders' ability to establish effective collaboration strategies with internal and external resources is responsible for the operational disruptions (Coupet & McWilliams, 2017; Ellström, 2015; Hayibor & Collins, 2016). The adverse implication of inefficient collaboration strategies is the gap in information flow between network resources (Lau, Singh, & Tan, 2015; Selviaridis, Matopoulos, Thomas Szamosi, & Psychogios, 2016; Vestrum, 2016). Similarly, factors such as lack of understanding of network partner's business needs can ignite operational disruptions (Shaffer & Dalton, 2014). Therefore, the organizational resources are the source of sustained business performance, as well as operational disruptions (Pfeffer & Salancik, 1978; Wolf, 2014).

The normal accident theory is similar to the bullwhip effect theory. Normal accident theorists assumed that some degree of operational disruptions is inevitable (Herbane, 2015; Kasdan, 2016; Larsson, Bynander, Ohlsson, Schyberg, & Holmberg, 2015; Perrow, 1999; Wrigstad, Bergstrom, & Gustafson, 2017). Nunan and Di Domenico (2017) argued that while some normal accidents are inevitable, some accidents are unanticipated and can cause operational disruptions that might amplify the bullwhip

effect. Hence, the leaders that engage with network partners that have hidden agendas leave the operational system vulnerable, thereby intensifying the occurrence of unanticipated accidents that might result in a bullwhip effect (Nunan & Di Domenico, 2017). The normal accidents are susceptible to integrated supply chain processes with varying business needs and expectations (Flynn et al., 2016). Integrated supply chain systems result in redundancies that lead to operational disruptions, which ignites the bullwhip effect (Asgary & Li, 2016).

Contrary to the bullwhip effect, proponents of the contingency theory argued that the drivers of operational disruptions are environmental uncertainty and unpredictability of market condition (Agigi, Niemann, & Kotzé, 2016; Jean, Wang, Zhao, & Sinkovics, 2016; Marshall et al., 2015). Contingency theorists claimed that operational disruptions stem from internal process inefficiency, external rivalry pressure, multicultural differences, social, economic, and environmental responsibilities (Arora, 2016; Gavidia, 2016; Milkovich, 2016; Luo & Yu, 2016; Pratono, 2016). Hence, contingency theorists imagined that supply chain leaders would need to install system-level flexibility to accommodate environmental changes to mitigate adverse effect on business performance (Birken et al., 2017; Boer et al., 2015; Hong Zheng & Marly Monteiro, 2016; Murray, 2015). Some contingency theorists postulated, for supply chain leaders to implement built-in contingency strategies, network partners could use to respond to environmental changes as needed (Luo & Yu, 2016; Murray, 2015; Pratono, 2016; Puranam, Alexy, & Reitzig, 2014)

Similar to the bullwhip effect theory, advocates of the agency theory claimed that the opportunistic nature of human behavior could cause operational disruption within a supply chain environment (Acquier, Valiorgue, & Daudigeos, 2017; Bendickson, Muldoon, Liguori, & Davis, 2016; Gancarczyk, 2016; Panda & Leepsa, 2017; Poniatowicz, 2017). A few agency theorists emphasized that an agent's self-interest might result in lack of trust between partners leading to an operational crisis that could amplify the bullwhip effect within a supply chain environment (Angkiriwang, Pujawan, & Santosa, 2014; Eisenhardt, 1989). Agency theorists assumed that leaders would explore the network partners political, social, legal, and ethical business practices that are in most cases, responsible for the amplification of the bullwhip effect (Angkiriwang et al., 2014; Eisenhardt, 1989; Fayezi, O'Loughlin, & Zutshi, 2012). Some leaders use the agency theory to address their transactional cost negotiation challenges, identify potential risks, and implement the mitigation plans as part of the partners' contractual and noncontractual agreements (Kultys, 2016). The reason was that the transaction cost theorists assumed that leaders would grow their business if they employ continuous improvement strategies to reduce the adverse implication of the market fluctuations (Coase, 1937; Mullaly, 2014; Wijethilake, Ekanayake, & Perera, 2015). The consequence is that while an organizational leader's business growth decisions might be good for business, the decisions might disregard the shareholders and stakeholders' needs (Gancarczyk, 2016). The agency and transactional cost theorists recognized the benefit of linking agency and transaction cost theories when engaging in a network business

relationship, as well as to dampen the bullwhip effect (Acquier et al., 2017; Gancarczyk, 2016; Poniatowicz, 2017).

The adverse implication of supply chain operational disruption continues to sharpen the discourse between the theorists, researchers, and practitioners. Consequently, theorists continue to intensify their arguments about the key drivers of operational disruptions based on the premise that optimized supply chain operational processes would dampen the bullwhip effect. Meanwhile, business leaders are keen on finding the optimum strategy to improve their supply chain performance, as well as attain customer satisfaction. Alternatively, consumers, stakeholders, and shareholders continue to demand economic, social, and environmental sustainability and a return on investments. The consensus shared by the theorists considering the knowledge gained from the existing body of literature was that supply chain disruption negatively affects operational performance. The theorists also proposed varying approaches to mitigate the amplification of the bullwhip effect. The fundamental propositions underlying the bullwhip effect theory are (a) component sourcing strategy, (b) component lead times, (c) component shortage escalation, (d) excess inventory management, and (e) component health evaluation (Isaksson & Seifert, 2016; Lee et al., 1997).

Component sourcing strategy. Supply chain leaders use outsourcing and offshoring to develop alliances with upstream and downstream partners. The partners may include global electronic component suppliers, product manufacturers, logistics providers, retailers, and customers (Desai et al., 2015). The leaders invest tremendous

resources in aligning their component sourcing strategies with their organization's system-level strategy to sustain their market position and gain a competitive advantage in a new market (Mikalef, Pateli, Batenburg, & Wetering, 2015). Flynn et al. (2016) and Mikalef et al. (2015) used contingency theory to evaluate the strategic positioning implications of the sourcing decisions of supply chain leaders. Researchers used network theory to analyze the relationship between supply chain partners and associated risks, postulating the need for risk mitigation plans at the various stages of the supply chain process (Jesus Felix, Fu, Xiao, & Rick Siow, 2018; Montenegro & Bulgacov, 2014; Weaver, Ellen, & Mathiassen, 2015). Mikalef et al. added that supply chain leaders could use the configuration theory to discover the relationship between other component sourcing risk elements that might affect the network alignment performance. Pongsuwan (2016) argued that a definite correlation existed between organizational spending and the sustainability of their component sourcing capability. A centralized approach has a greater sourcing capability maturity than the decentralized sourcing approach (Pongsuwan, 2016). Boughzala and De Vreede (2015) proposed a generic measurement system that supply chain leaders could use to measure the efficiency of their horizontal and vertical partner collaboration quality as well as the effectiveness of their sourcing strategies.

The consumer demand variations and fierce rivalry competition continued to exert tremendous communication inaccuracies within the supply chain network (Desai et al., 2015). The communication inaccuracies occur as demand and supply data travels through

the supply chain process sites (Desai et al., 2015). Any distortion of the demand data has the potential to increase the bullwhip effect along the process sites. Similarly, demand data distortion can trigger component shortage crises, which might lead to delay in customer product delivery (Chatterjee et al., 2015; Isaksson & Seifert, 2016; Jaipuria & Mahapatra, 2015; Taylor, 2016; Zhang & Xi-Gang, 2016). For some organizations, delay in product shipment to the customers means a delay in obtaining payment for orders; therefore, jeopardizing the cash flow of the company (Akanbi & Fagade, 2014; Igwe, Robert, & Chukwu, 2016; Yilmaz et al., 2016).

Lee, Lin, and Pasari (2014) postulated that supply chain leaders would benefit from spot buying during raw material volatility periods. The best component sourcing approach to employ during the period of demand and supply uncertainties is a combination of both the contract deal and the spot buying strategies (Lee et al., 2014). Mikalef et al. (2015) emphasized that organizational leaders use strategic positioning to drive the component sourcing strategy. Therefore, a consideration of several component sourcing factors would result in better sourcing alignment (Mikalef et al., 2015). Mikalef et al. postulated for supply chain leaders to exert operational excellence, they should take advantage of contract bidding to improve strategic positioning. A decentralized sourcing strategy, large supply base, and organizational size are the key features that would benefit the market leaders of products (Mikalef et al., 2015). Conversely, centralized sourcing strategy, flexible contract bidding, and large supply base are the best sourcing strategies

for the organizational leader whose strategic positioning involves a close relationship with the customers (Mikalef et al., 2015).

Chatterjee et al. (2015) acknowledged the existing body of knowledge and the models developed by previous researchers was to enable suppliers and buyers to improve their value creation. One of the models was for the buyers to apply an economic order quantity strategy in their sourcing processes. Chatterjee et al. contended that although economic order quantity might offer some cost-saving strategic decision for the buyers, the decision might impose a significant financial burden on the suppliers because the supplier may incur retooling fees to fulfill the next batch of the buyer's order. The suppliers use the model to mitigate the re-tooling cost impact. Chatterjee et al. introduced the rebate program model to motivate the buyer to place batch orders resulting in higher product quantity compared to the economic order quantity program that the buyer valued. The third model relates to the vendor managed inventory program, a scenario where the buyer prefers for the supplier to hold excess inventory on their book until the buyer is ready to use the material (Chatterjee et al., 2015; Dong, Dresner, & Yao, 2014). However, if the bullwhip effect occurs because of a market shift, the implication is the inefficient execution of the vendor managed inventory program resulting in added excess inventory cost (Chatterjee et al., 2015; Dong et al., 2014).

Component lead times. Some electronic component supply chain leaders continue to experience an amplified bullwhip effect within the supply network (Akanbi & Fagade, 2014; Li, Liu, & Huang, 2014; Sadeghi, Makui, & Heydari, 2016; Zhu, Krikke,

& Caniëls, 2016). The consumer demand surge for electronic products, extended component lead-times, and threatening allocation risks are some of the factors causing the amplified bullwhip effect (Akanbi & Fagade, 2014; Li et al., 2014; Sadeghi et al., 2016; Zhu et al., 2016). The component lead-time, shortages, order rationing, and inefficient operational processes are the fundamental constructs that cause amplification of the bullwhip effect within the network (Taylor, 2016). Forrester (1961) used data collected from IT companies to evaluate the lead-time effect on various supply chain sites. Taylor (2016) noted that the supply chain partners respond with panic when a delay in communicating demand data along process sites occurs. The network partners are concerned about the uncertainty in component availability and the potential effect on customer order shipment schedule (Taylor, 2016). Igwe et al. (2016) claimed that timely delivery of customer orders is a means for supply chain leaders to improve customer satisfaction rates, as well as operational performance and revenue generation.

Bandaly, Satir, and Shanker (2016) asserted that lead-time variability alone does not negatively affect supply chain performance. However, sustained lead-time variations would justify the leaders need to consider a coordinated supply chain management strategy (Bandaly et al., 2016; Golini, Caniato, & Kalchschmidt, 2016). Taylor (2016) added that supply chain leaders fear that a sustained unpredictable component availability could negative affect the on-time delivery of customer order. Therefore, inefficient supply chain processes create a lag in information flow between downstream and upstream network partners that might induce long lead-time of the components (Dennis,

Muthukumaran, & Balaji, 2015; Taylor, 2016). The use of remanufactured components could help to reduce lead-time (Erol & Nakiboglu, 2017; Lu et al., 2015; Qiang & Zhou, 2016; Yerramalli & Burra, 2014; Zhu, Wang, & Tang, 2017). Cannella, Dominguez, Framinan, and Bruccoleri (2018) noted that leaders should use infrastructure systems to achieve real-time information sharing to reduce lead-time concerns and achieve on-time delivery of customer orders. Supply chain leaders use factory capacity flexibility and equipment prioritization to manage variable market products to minimize lead-time variability and reduce the bullwhip effect (Christopher & Holweg, 2017; Zhang, Hou, Zhang, & Zhang, 2017).

Zou and Ye (2015) warned that the rework cost, quality condition, and inventory level are some of the risks associated with using remanufacturing components to build products. Yilmaz et al. (2016) recommended for leaders to use effective partner collaboration to positively influence a collaborative advantage, which in turn, would improve supply chain performance. Long-term supplier retention may benefit organizational leaders in building continued consumer loyalty while mitigating component supply risks (Mamavi et al., 2015). Pathak (2016) added that network partners use information sharing of demand requirements, available capacities, and component supply availability to adjust tactics proactively to reduce lead-time concerns and achieve on-time delivery of customer orders.

Component shortage. The customers' demand for varying electronic products follows the rapid technology advancement trend. The fluctuating demand results in

increased pressure on the suppliers of electronic components' ability to meet the supply needs of customers (Yerramalli & Burra, 2014; Zhang & Xi-Gang, 2016). Zhang and Xi-Gang (2016) asserted that some supply chain leaders changed their focus to investing and managing current and forward-looking demands. Nevertheless, using only new technology components to build new products contributes to the component shortage events (Zhang & Xi-Gang, 2016). Isaksson and Seifert (2016) outlined the component shortages drivers as (a) the strategies partners are using to forecast demand, (b) order batching driven by economies of scale, (c) price fluctuations due to local risk factors, and (d) shortage gaming that buyers use to secure buffer material. Moraitakis, Huo, and Pfohl (2017), in agreement with Isaksson and Seifert, noted that lead-time, shortage gaming, and order batching are the driving factors that amplify the bullwhip effect within the supply chain network. Ahmad and Zabri (2018) noted the benefit of using a forecast management system to account for inventory levels and to manage demand variability. Choudhury (2018) recommended the use of a forecast management system to reduce demand variability implications while sustaining partner relationship, business growth, and competitive advantage. Lee and Suk-Chul (2016) added that lack of transparency within supply chain partners contributes to the component shortage problems. Lack of predictability of material readiness visibilities can result in process inefficiencies, which directly affect customer satisfaction and supply chain performance (Lee & Suk-Chul, 2016).

Chatterjee et al. (2015) used the bullwhip effect theory to explain the effect of unpredictable demand on component shortages. The adverse economic consequence of component shortage is the reduction in revenue generation that stems from the loss of sales, production waste in the form of idle time, and customer dissatisfaction (Akanbi & Fagade, 2014; Madhani, 2017; Sadeghi et al., 2016). Zhang and Xi-Gang (2016) suggested the application of reuse and remanufacturing of obsoleted electronic products content to reduce component shortages; therefore, reducing the bullwhip effect. Supply chain leaders mitigate component shortages using technology innovation and flexible manufacturing strategies (Akhtar, Raza, & Shafiq, 2018; Zhang, Na, Niu, & Jiang, 2018). Asadi, Jackson, and Fundin (2017) found that supply chain leaders use technology innovation and flexible manufacturing during seasonal market periods to dampen the bullwhip effect on their electronic component supply chain. Sharma, Sachdeva, and Gupta (2017), in agreement with Asadi et al., noted that supply chain leaders use a flexible manufacturing approach to reduce the bullwhip effect and improve operational performance. The use of recycled components offers unique benefits, such as assurance of component availability (Yerramalli & Burra, 2014; Zhang & Xi-Gang, 2016). Synáková (2017) cautioned that the accumulation of component inventory during a market softening cycle has adverse economic consequences. The inventory carrying-cost could restrict the supply chain resources that stem from excess inventory leading to component obsolesces, and adverse human resource effect (Synáková, 2017). Synáková evaluated the use of inventory smoothing technique to reduce the bullwhip and whiplash

effects. Synáková stated that smoothing both the order and demand variances would reduce the component shortages problems.

Excess inventory management. An amplified bullwhip effect can negatively affect the predictability of electronic component availability, increase excess inventory spend, and reduce operational performance (Isaksson & Seifert, 2016; Jaipuria & Mahapatra, 2015). Bruccoleri, et al. (2014) asserted that practitioners use critical metrics to measure supply chain performance, such as inventory management, the human effect, product quality, and customer satisfaction. Ingy Essam (2017) noted that effective supply chain leaders implement a resource management strategy to reduce excess inventory, improve operational performance, and enhance systems capabilities. Govind, Rose, and Pisa (2017) noted the need for the use of appropriate metrics to monitor forecast data to reduce the bullwhip effect.

Croson and Donohue (2006) noted that the bullwhip effect is a consequence of the rational behavior of the leaders under the imposed supply chain structure and processes. Angkiriwang et al. (2014) argued that the component availability concern is one of the key drivers of supply uncertainty that leads to excess inventory. Synáková (2017) stated that inventory fluctuation during the upsurge market cycle is a key factor regarding excess inventory accumulation at the different sites of the supply chain operation. May, Atkinson, and Ferrer (2017) noted the need for effective management of inventory levels at each network process step to anticipate demand surge and reduce the bullwhip effect. The inventory stock out and stockholding phenomenon originated from bullwhip effect

observed in the downstream and upstream supply chain process sites (Synáková, 2017). Kumar (2017) advocated for supply chain leaders to use inventory level monitoring to recognize the demand signals transmitted to and from network partners. Steven and Brito (2016) contended that the offshoring and outsourcing of some of the supply chain operations to emerging market is one of the key contributors to process inefficiencies that ignite the bullwhip effect and accumulation of excess inventory within the network. In disagreement, Taylor (2016) argued that the process inefficiencies stem from random demand events that lead to excess inventory accumulation and reduces operational performance. Schulz and Flanigan (2016) argued that financial performance was not the only measure of a supply chain success.

The nonfinancial factors, such as human capital and operational environment, play a critical role in the operational performance (Schulz & Flanigan, 2016). The human capital provides skills and technical competencies that the supply chain needs to create value (Schulz & Flanigan, 2016). Synáková (2017) argued that the supply chain operational inefficiencies lead to huge wastes as well as add hidden operational costs. The waste stems from a variation in manufacturers' capacity planning, changes in the mode of transportation, inventory obsolesces, schedule production fluctuations, and poor customer service (Synáková, 2017). Desai et al. (2015) agreed with Synáková in that reactive management of operational crisis leads to inefficient supply chain processes. Conversely, Desai et al. claimed that demand variations contribute to the operational

crises within the supply chain environment requiring human capital to manage the crisis reactively.

Bruccoleri et al. (2014) conducted a continuous-time analysis model to explore the human effect on inventory recording. Bruccoleri et al. aimed to identify the impact of workers' environment on inbound inventory recording. Bruccoleri et al. emphasized social and environmental factors that influence human capital emotional state can have significant implication to on demand and supply variability. Concurrently, Jaipuria and Mahapatra (2015) stated that amplified demand variation affects supply chain operational performance measures, such as raw materials, finished goods inventory, work in progress, and material availabilities. Botha, Grobler, and VS (2017) contended that market fluctuation is the root of the operational inefficiencies. The manufacturer partners tend to add capacities during the market surge cycle (Hwang, Chen, & Lin, 2016). Lucie (2017) noted that leaders use human capital to expand the production line capacity to meet the retailer's demand increase. The excess inventory build-up occurs during the market surge cycle, but when the market settles and enters the slow cycle, the material costs and profitability softens (Hwang et al., 2016).

The supply chain partners face tremendous challenges with excess inventories, idle equipment capacity, and human capital dissatisfaction (Hwang et al., 2016). Wolf (2014) noted that reactive management of operational crisis results in high utilization of human capital. Overutilization of human capital might adversely affect the supply chain’s social and environmental sustainability (Wolf, 2014). Bruccoleri et al. (2014) affirmed

that the adverse human effect stems from high resources utilization and stress from social, environmental, and economic sustainability factors. Wolf suggested for supply chain leaders to integrate human capital's expectations to the supply chain system-level management strategies to improve member longevity that correlates with sustained operational performance. Mohan and Chitale (2016) contended that the inventory bullwhip effect stems from the unpredictable demand that may result in excess or unused material that might arise from the downstream or the retailer part of the supply chain triggering the bullwhip effect phenomenon (Mohan & Chitale, 2016). Some retailers tend to maintain inventory stock within a specified period. However, the inventory stocking strategy can put the retailer at risk of incurring a hidden cost if the old stock is unsold within the given period (Mohan & Chitale, 2016). Therefore, the cost associated with the unsold product handling and storage would creep in unnoticed. Hence, supply chain leaders need to develop profit level visibility to enable retailers to control the inventory selling process as well as mitigate the influence of bullwhip effect along the supply chain system.

Component quality and reliability. The consumer demand for high-quality products puts tremendous pressure on suppliers of electronic products to consistently sustain component quality and reliability while staying competitive (He, He, Wang, & Gu, 2015; Zhang & Xi-Gang, 2016). The quality and reliability of components used to build electronic products are factors influencing customer satisfaction (Marques-Costa, da Silva-Vieira, Pereira-Lopes, Cabral-Leite, & Tetsuo-Fujiyama, 2016; Zhang & Xi-

Gang, 2016). Some supply chain leaders are concerned about maintaining components quality and reliability, starting with new product introduction through the projected end-of-life of the product (Marques-Costa et al., 2016; Paduraru, Tudor, Petrescu, & Plotog, 2016; Valverde & Saadé, 2015; Yerramalli & Burra, 2014). Leaders need to ensure that the component suppliers possess the capability to provide technical support for parts that are on end-of-life status (Valverde & Saadé, 2015; Yerramalli & Burra, 2014). Illés, Horváth, Géczy, Krammer, and Dusek, (2017) and Paduraru et al. (2016) contended that efficient mechanical attachment and assemblies of known good electronic component solder joints to the printed circuit boards facilitate the sustainability of the components quality and reliability. Illés et al. and Paduraru et al. suggested for leaders to align with component suppliers that strictly follow the global Joint Electron Device Engineering Council (JEDEC) standard for the attachment and qualification of the electronic component on the printed circuit boards. Researchers emphasized the need for supply chain partners to utilize the JEDEC requirements to communicate and manage changes that might affect the component functionality (Illés et al., 2017; Liu, Meng, & Zhao, 2013; Paduraru et al., 2016; Zhang, Xi, Liu, & Ding, 2013). Tiku, Azarian, and Pecht (2007) noted that component suppliers use product change notifications to communicate changes that might affect components' fit, form, or function.

Hwang et al. (2016) and Mourtzis (2016) complained that consumer demand for electronic products variety with short life cycles is increasing supply chain complexities. The supply chain leaders that are experiencing operational complexities lack strategies to

sustain component and product quality standards (Hwang et al., 2016; Mourtzis, 2016). Angkiriwang et al. (2014) noted that leaders should exert product quality and reliability to differentiate their brand to remain relevant in a competitive market. Leonczuk (2016) noted that supply chain performance significantly relates to customer satisfaction. Therefore, proper delivery of high-quality products at a specific timing to the customers is a good measure of supply chain performance (Leonczuk, 2016). Hwang et al. contended that the success factor for effective supply chain management is the ability for leaders to select the appropriate network partners. Lee and Rha (2016) suggested for leaders to use a combination of the dynamic capability and ambidexterity to establish a built-in immune system that would enable the network partners to reduce quality disruptions and improve operational performance.

Chen (2016) argued that the appropriate partner selection approach is for the leaders to employ single source supplier or manufacturer that is willing to share their strategy to sustain component and product quality. Alternatively, leaders are to employ dual-source suppliers or manufacturers only in a situation where a supplier or manufacturer is unwilling to share strategy to sustain component and product quality investment. Hwang et al. (2016) posited for leaders to assess prospective suppliers' business practices and technical capabilities to ensure that they can reliably meet the supply chain's business principles and technical requirements. The supply chain leaders need to use quality reviews, such as engineering capability, process control capability,

final inspection capability, quality records, and technological readiness as part of the key criterion for network partner selection (Hwang et al., 2016).

Complementary and Contrasting Theories

Resource dependence theory. Pfeffer and Salancik (1978) introduced the resource dependent theory (RDT) based on the premise that leaders use organizational resources to drive performance. Supply chain leaders use organizational resources to create value, sustain short-term business imperatives, influence long-term growth opportunity, and enable sustained competitive advantage (Al-Zu'bi, 2016). Wolf (2014) stated that the leader's ability to align the organization strategies with appropriate resources facilitates long-term business sustainability. Proponents of the RDT argued that supply chain leaders should establish an end-to-end collaborative approach to influence and achieve sustained performance (Coupet & McWilliams, 2017; Ellström, 2015; Vestrum, 2016). Wolf used RDT to study the influence of stakeholder pressure, management decisions, and corporate sustainability practices on public perception of an organization's ability to be sustainable. Supply chain leaders use network member collaboration to acquire resources to facilitate the reduction of operational inefficiencies (Hinkelmann et al., 2015; Wijethilake et al., 2015). RDT literature indicated the value of organizational leaders' ability to align internal and external resources to reduce supply chain operational inefficiencies and achieve a sustained competitive advantage (Hayibor & Collins, 2016; Lau et al., 2015; Selviaridis et al., 2016). The assertion was that organizational leaders employ RDT to establish dependences for each network partner to

sustain resources that benefit each network member (Pfeffer & Salancik, 1978). Hayibor and Collins (2016) contended that the management of supply chain partners requires more than collaboration, coordination, and alliance.

Supply chain network partners need a more profound understanding of each network partner's needs (Shaffer & Dalton, 2014). Organization leaders need to install technological tools to foster regular cross-competence training, form personal relationships, and implement consistent audit programs and risk mitigation plans (Shaffer & Dalton, 2014; Shukla & Naim, 2017).

Wolf (2014) examined the relationship between the triple constraints of external stakeholder pressure, corporate sustainability responsibilities, and supply chain management priorities using data from 1,621 organizations. The results indicated that stakeholder pressure, resource availability, and supply chain management strategies influence organizations to sustain a competitive advantage (Wolf, 2014). In agreement with Wolf, Foerstl et al. (2015) asserted that direct stakeholder and consumer pressure are the primary drivers that influence supply chain partners who are responsible for the finished goods to implement sustainable supply chain management practices. Marshall et al. (2015) contented that competitive advantage was not the key driver of supply chain sustainability. The environmental regulatory and efficiency forces drive supply chain's sustainability (Marshall et al., 2015). Foerstl et al. and Marshall et al. agreed that some leaders find implementing sustainable business practices challenging because of external pressures and government regulations influences. Meanwhile, using sustaining efficient

business practices within the supply chain processes helps to reduce operational crises that trigger the bullwhip effect (Foerstl et al., 2015; Marshall et al., 2015).

Normal accident theory. Nunan and Di Domenico (2017) argued that the complexity of supply chain management leaves the organizational system vulnerable to normal accidents that are both unanticipated and inevitable. Perrow (1999) formulated the concept of normal accident theory on the premise that accident is unavoidable especially within a complex integrated system. A system is an organizational value chain comprising of multiple levels of process integration, such as supply chain network consisting of buyers, suppliers, subsuppliers, manufacturers, and retailers (Perrow, 1999). Jaradat, Adams, Abutabenjeh, and Keating (2017) noted that supply chain leaders use process integration as a strategy to improve operational visibility, minimize component shortages, and reduce the bullwhip effect. Mishra, Pundir, and Ganapathy (2017) noted process integration is a means for supply chain leaders to improve real-time information sharing with internal and external network partners. Perrow argued that members of the supply chain network expect some component level failure accidents, whereas system-level accidents involve multiple failures with ripple effect within a subsystem in an unanticipated manner. Integrated supply chain systems become increasingly complex when network members connect to partners' systems leading to redundancies and operational inefficiencies.

Perrow's normal accident theory spawned several research interests relevant to the cause, implications, and mitigation of normal accidents (Herbane, 2015; Kasdan,

2016; Larsson et al., 2015; Nunan & Di Domenico, 2017; Wrigstad et al., 2017). Marley, Ward, and Hill (2014) noted that supply chain leaders could more efficiently assess the severity of normal accident threats and implement corrective actions if they proactively manage operational disruptions. Meanwhile, the proponents of normal accident theory argued that accidents or operational disruption are inevitable in complex integrated systems (Herbane, 2015; Kasdan, 2016; Larsson et al., 2015; Nunan & Di Domenico, 2017; Wrigstad et al., 2017). Flynn et al. (2016) added that some supply chain leaders try to use process integration to respond to the bullwhip effect threats, yet the bullwhip effect within the supply chain system is unavoidable because of the supply chain complexity.

Supply chain integration is limited to linking partners' processes to influence informational, operational, and relational collaboration. Flynn et al. (2016) claimed that the three key drivers of supply chain bullwhip effect are variability of demand input, communication gap, and ambiguous output from the system process. Moussaoui, Williams, Hofer, Aloysius, and Waller (2016) argued that the major contributors of supply chain operational inefficiencies are a) managerial decisions, b) human effect, and c) coordination actives. The contention is that the key contributors of supply chain inefficiencies amplifies the bullwhip effect (Moussaoui et al., 2016). Conversely, Asgary and Li (2016) stated that integrating the Western supply chain operational systems with emerging market partners systems might lead to unethical business practice. Unethical business practices might result in huge revenue and brand loyalty losses to the corporation in the long run (Asgary & Li, 2016).

In agreement with Asgary and Li (2016), Pournader, Rotaru, Kach, and Razavi Hajiagha (2016) stated that integrating supply chain partners activities was not a valid interruption risk mitigation method. Pournader et al. suggested for supply chain leaders to adopt a combination of system-wide and tier-specific integration strategies to reduce supply chain interruption risks. Flynn et al. (2016) noted that supply chain leaders could reduce both demand input and communication gap interruptions through proactive management of the incoming data, timely communication, and adequate assessment of the information. Pournader et al. contended that integrating supply chain partners activities was not sufficient method to mitigate supply chain interruption risks. Flynn et al. recommended for all the drivers to coexist and interact with each other to dampen the bullwhip effect. Pournader et al. argued for supply chain leaders to adopt system-wide and tier-specific integration strategy to achieve supply chain resilience. Flynn et al. posited for leaders to employ the nonmedia communication tools, such as a shared database, excel spreadsheet, contract, and policies, as instruments to respond to both input and output interruptions.

Contingency theory. Some supply chain leaders face both internal and external environmental pressures within their operational locations. The environmental factors stem from internal process inefficiency, external rivalry pressure, multicultural differences, social, economic, and environmental responsibilities (Agigi et al., 2016; Jean et al., 2016; Marshall et al., 2015). To mitigate the adverse implication of known and unknown environmental factors, the contingency theorists suggested for organizations to

align their processes to fit the operational structure to accommodate changes within the environment (Arora, 2016; Gavidia, 2016; Milkovich, 2016). Flynn et al. (2016) and Mikalef et al. (2015) used contingency theory to evaluate supply chain organizations' strategic positioning implications on their sourcing decisions. Althernatively, other researchers used contingency theory to explore the effect of environmental uncertainty and unpredictability of market condition on organizational performance (Arora, 2016; Gavidia, 2016; Milkovich, 2016; Luo & Yu, 2016; Pratono, 2016). Meanwhile, a different group of researchers used contingency theory to identify the optimum strategy to manage supply chain events under a dynamic situation (Arora, 2016; Gavidia, 2016; Milkovich, 2016; Luo & Yu, 2016; Pratono, 2016). I applied contingency theory to explore the implications of environmental forces on the bullwhip effect.

The contingency theory continues to gain broad research attention (Birken et al., 2017; Boer et al., 2015; Hong Zheng & Marly Monteiro, 2016). The proponents of contingency theory argued that supply chain operations management requires flexibility to mitigate environmental risks and achieve business performance (Birken et al., 2017; Boer et al., 2015; Hong Zheng & Marly Monteiro, 2016; Murray, 2015). Some supply chain leaders use built-in contingencies to develop and implement appropriate strategies to respond to environmental changes (Luo & Yu, 2016; Murray, 2015; Pratono, 2016; Puranam et al., 2014). Flynn et al. (2016) used the contingency theory to test the relationship between demand input, communication gap, and environmental factors. Puranam et al. (2014) noted that the environmental uncertainty includes the adverse

effect of demand variability driven by consumer forces, intense competition from rivalries, and disruptive technological advancements. As such, some supply chain leaders who lack effective operational management strategies suffer the consequences of an unpredictable market condition (Jean et al., 2016; Milkovich, 2016). Because of the unpredictable market condition, the supply chain leaders have trouble in predicting consumer preferences, the volume of products to push to the market, and might lose track of the ever-changing technology generations (Abbas & ul Hassan, 2017; Arora, Arora, & Sivakumar, 2016; Carbonell & Rodriguez Escudero, 2015; Puranam et al., 2014).

Kim and Chai (2016) used the contingency theory to investigate the effect of supply chain integration under uncertain environmental conditions and the implications on the organizational performance. The outcome of the study indicated support for the contingency theory in that leaders use effective contingency strategies that fit operational processes to quickly respond to environmental changes and improve operational performance (Kim & Chai, 2016). From a holistic perspective, researchers use contingency theory to influence the evaluation of the organizations' strategic positioning, features, and leadership decisions (Mikalef et al., 2015). Bala (2014) asserted that supply chain disruption is one of the most significant challenges that organizational leaders face. Supply chain disruptions are factors regarding adverse consequences for customer satisfaction, operational performance, revenue generation, and profitability (Bala, 2014). Mamavi et al. (2015) added that a supply chain disruption is a consequence of unintegrated processes especially in an environment where network partners are

operating under varying priorities. Inefficient collaboration and communication strategies create complexities and add unanticipated operational costs (Nagashima et al., 2015). Ma Gloria (2017) noted that an integrated process is a means for supply chain leaders to improve joint decision-making and responsiveness to reduce component shortage concerns during unanticipated demand surge and dampen the bullwhip effect. Wang et al. (2014) acknowledged that researchers had conducted extensive studies aimed to provide strategies to reduce supply chain disruptions. Wang et al. contended that despite the extant literature contribution, some organizational leaders continued to manage the consequences of supply chain disruption reactively. Organizations would improve their performance by using effective contingencies to revise their processes to adapt to the dynamic environmental forces (Kim & Chai, 2016; Luo & Yu, 2016; Murray, 2015).

Agency and transactional cost theories. Agency theorists assume a business engagement from the perspective a contractual agreement between principal organizational leaders and business partners (agent) to perform specific activities that the principal organization cannot achieve (Bendickson et al., 2016; Eisenhardt, 1989). Agency theorists asserted that the opportunistic nature of human behavior could lead to self-interest because the agent might not act in the best interest of the principal organization (Bendickson et al., 2016; Panda & Leepsa, 2017). The agent's self-interest might result in lack of trust, low-quality product, and customer dissatisfaction (Angkiriwang et al., 2014). Transaction cost theorists suggest for organizations to grow through continuous improvements, and inevitability in market demand for competition,

innovation, low-cost, high-quality products, and services (Coase, 1937; Mullaly, 2014; Wijethilake et al., 2015).

The link between agency and transaction cost theories was that the agent could make decisions based on his or her self-interest (Acquier et al., 2017; Gancarczyk, 2016; Poniatowicz, 2017). Nevertheless, the leaders' decisions may result in rapid business growth (Gancarczyk, 2016). Whereas in transaction cost, the leaders' decisions to grow the business under bounded rationality could create a gap between the organizational needs, the shareholders' needs, and stakeholders' needs (Gancarczyk, 2016; Usmanova & Orlova, 2016; Yap, Lim, Jalaludin, & Lee, 2016). The separation between the scaled organizational needs and the shareholder's needs might constrain the shareholder's voice relevant to the direction of the business decisions (Panda & Leepsa, 2017; Yilmaz et al., 2016).

Proponents of agency and transaction cost theories stressed the need for sociologists and economists to collaborate to develop fundamental business engagement models (Hirsch, Michaels, & Freidman, 1987). Hirsch et al. (1987) argued that effective collaboration and knowledge sharing between sociologists and economists would enable researchers to explore social science phenomenon from multiple worldviews. Eisenhardt (1989) contended that researchers should use agency theory to focus primarily on exploring strategies to mitigate the drivers of conflicts during contract negotiations. Fayezi et al. (2012) added that researchers use agency theory to understand the dynamics of supply chain member behaviors and relationships relevant to political, social, legal,

ethical business practice, and behavioral forces. Nevertheless, supply chain leaders use agent theory as a tool to address the limiters of transactional cost negotiation to implement risk mitigations as part of the contractual and noncontractual agreements (Kultys, 2016). Hence, the critical driving negotiation factor is a mutual or conflicting interest shared by the parties (Kultys, 2016). I employed the agency and transaction cost theories to explore the effect of (a) shareholders and stakeholders' expectations, (b) negotiation tactics, and (c) bullwhip on social, economic, environmental, and supply chain performance.

Shareholders and stakeholders expect business leaders not only to grow the business but also to deliver a return on their investment while sustaining social, environmental, and economic responsibilities (Yawar & Seuring, 2017; Yilmaz et al., 2016). Maintaining business growth through operational performance and achieving social and environmental requirements creates several challenges for global business leaders (Dubrovsky, Yaroshevich, & Kuzmin, 2016; Wolf, 2014). Western business leaders explored alternative strategies because of local market saturation, low profitability, high tax rates, and high labor costs (Al-Zu'bi, 2016; Igwe et al., 2016; Wolf, 2014). The business leaders' vision is to improve their product quality, distinguish their brand, and empower creativity, collaboration, and innovative ideas (Igwe et al., 2016). The mission is to exert system-thinking strategies to ignite new product and service readiness while achieving timely and safe delivery of products and services at low-cost and high quality (Igwe et al., 2016).

Meanwhile, the untapped emerging market potentials had become the *breeding ground* for business growth opportunities; therefore, attracting global business entry (Wolf, 2014). Some business leaders employ concentric diversification strategy to penetrate the emerging market to deliver on their promises to shareholders and stakeholders (Rijamampianina, Abratt, & February, 2003). A part of the diversification strategy might include a scenario where the principle supply chain leaders use negotiation tactics to enters into contract with external partners to perform specific operational function, in return, the principal organization agrees to reward the partners for their service (Kultys, 2016; Prosman, Scholten, & Power, 2016). However, the globalization effect added a different layer of complexities to contract negotiation (Chari, Luce, & Thukral, 2017; Palich, Carini, & Livingstone, 2002). The global implications are that the supply chain leaders would need to penetrate cultural barriers to engage the prospective business partners (Mitnick, 2015). Ma, Chen, and Zhang (2016) acknowledged that contract negotiation actors could experience challenges driven by cultural differences during the contract negotiation phase. Mitnick (2015) added that some the driving factor of the cultural difference challenges is that some negotiation actors lack in-depth knowledge of the opposing party's intentions and their system capabilities at the beginning of the negotiation. Therefore, the fear of the unknown risks creates doubt about potential opportunism in the minds of the principal organizational leaders (Mitnick, 2015).

The market stagnation in Western regions and the untapped potentials in the emerging market regions are the drivers of global supply chain initiatives (Huang et al., 2014; Igwe et al., 2016). Hence, some Western business leaders made strategic decisions to penetrate the emerging market in search of low-cost labor, tax advantages, and economies of scale to achieve sustained business growth and a competitive advantage (Al-Zu'bi, 2016; Huang et al., 2014; Steven & Brito, 2016). Some of the leaders employed offshoring and outsourcing strategies to penetrate the emerging market (Steven & Brito, 2016). Verhoeven and Johnson (2017) noted that the outsourcing of some portions of supply chain activities was a good strategy for supply chain leaders to focus resources on key operational competencies. Marhamati, Azizi, and Marhamati (2017) offered that supply chain leaders could use IT systems distribute component sourcing across several regions to mitigate component shortages and reduce bullwhip effect. The leaders utilized the offshoring and outsourcing strategies to form alliances with global partners, develop a cross-cultural network, acquire intercultural competencies, and gain access to new market (Steven & Brito, 2016). Therefore, the supply chain activities involve contractual agreement between participating partners (Foerstl et al., 2015). Steven and Brito (2016) asserted that while the Western leaders that penetrated the emerging market are continuing to benefit from low-cost labor, minimum tax rates, and succeeded in attracting component suppliers and subsuppliers to cluster near the emerging market factories, they leaders are also encountering some operational challenges. Other researchers added that the adverse implication of the emerging market

penetration relates to social, economic, and environmental challenges (Jasko, Jovanovic, & Cudanov, 2015; Yilmaz et al., 2016). The assertion is that some of the Western leaders engaged in the global supply chain initiatives underestimated the full impact of unintended consequences of inefficient operations (Jasko et al., 2015; Steven & Brito, 2016; Yilmaz et al., 2016). Steven and Brito affirmed that shifting parts of supply chain operations to the emerging market contributes to operational inefficiencies that trigger the bullwhip effect.

The operational inefficiencies, such as the bullwhip effect driven by demand and supply disparities and human effect, can result in low-quality products, hidden operational cost, and customer dissatisfaction (Bruccoleri et al., 2014; Sander & Janovsky, 2016; Wolf, 2014). The bullwhip and human effect add complexities to the supply chain environment (Bendickson et al., 2016; Coulson-Thomas, 2014; Forrester, 1961). Windeler, Maruping, Robert, and Riemenschneider (2015) acknowledged that global supply chain had enabled network partners to collaborate to achieve a common objective. Windeler et al. contended that conflict is unavoidable in a complex multicultural environment. Effective global supply chain leaders use a partner accountability approach to mitigate hidden operational cost, ensure component availability, and reduce the bullwhip effect (Domański & Adamczak, 2017; Negawo & Singla, 2017). The globalization effect added a different layer of complexities to negotiations between Western business leaders and foreign actors (Ma et al., 2016). The global implication is the effects on the principal organization when penetrating cultural

barriers to engage in negotiation with a prospective foreign business partner (Gotsis & Grimani, 2016). Ma et al. (2016) argued that cultural differences significantly contribute to the international contract negotiation challenges. The assertion is that each participating party possesses self-interests about the expected outcome of the negotiation (Lokkesmoe, Kuchinke, & Ardichvili, 2016; Paik & Tung, 1999; Palich et al., 2002; Tse, Francis, & Walls, 1994). However, each party understands the risk of not achieving the business objectives without aligning with the opposing party (Bendickson et al., 2016; Ma et al., 2016).

Global Supply Chain Management

The supply chain is a network of multiple business entities that enters into a business agreement based on a shared vision of creating value for shareholders, stakeholders, and consumers (Chen, 2016). Al-Zu'bi (2016) noted that some corporate leaders aim to use the supply chain framework to accomplish their system-level objectives driven by the leader's vision of business growth and profitability. Part of the leader's value proposition is to strategically use the supply chain network to produce high-quality products and services that meet consumer needs, reduce operational cost, generate revenue and profit margin, and achieve sustained business growth (Plugge, Borman, & Janssen, 2016). To sustain business growth, leaders need to leverage the network partners as the tool to optimize operational processes, maximize speed, and efficiencies (Al-Zu'bi, 2016; Chen, 2016).

Igwe et al. (2016) asserted that some supply chain leaders continuously seek the effective strategy to distinguish their corporate brand because of the dynamic and highly competitive markets. Qureshi and Abdulkhalaq (2015) suggested for the struggling leaders to exert system-thinking strategy to empower creativity, collaboration, and innovative ideas across their network partners. Tieman (2017) found that efficient supply chain management requires a consistent communication flow between network partners. Foerstl et al. (2015) argued that the consumer demand for business sustainability practices and intense competition among rivalries are the main reasons some of the supply chain leaders want to differentiate their product offering, as well as protect the integrity of the corporate brand reputation. Igwe et al. insisted product quality and serviceability are the key criteria that leaders should use to differentiate their product brand. Storer, Hyland, Ferrer, Santa, and Griffiths (2014) reasoned that, although some leaders employ the supply chain network to chaperon their corporate objectives, the management of supply chain operations presents tremendous challenges that threaten customer satisfaction and business sustainability.

Foerstl et al. (2015) noted that stakeholder, shareholder, and consumer pressure as significant drivers that influence the implication of supply chain management. Yilmaz et al. (2016) noted that the supply chain leaders that operate in a multidimensional and competitive market are constrained by both internal and external environmental factors. In agreement with Yilmaz et al., Al-Zu'bi (2016) and Wolf (2014) affirmed while the leaders strive to achieve operational performance, as well as meet consumer demand for

social and environmental responsibilities, the leaders also face challenges associated with sustain business growth. Yilmaz et al. emphasized that the corporate shareholders and stakeholders expect leaders not only to grow the business, but also to deliver a return on their investment while sustaining social, environmental, and economic responsibilities.

The supply chain leader's ability to sustain business growth presents a different set of challenges for Western corporations (Steven & Brito, 2016). The problem stems from the observed regional market saturation, low product profitability, high-tax rate, and high-labor-cost (Steven & Brito, 2016). In response, the Western supply chain leaders sought to explore alternate strategies to sustain their market position, grow the business, generate revenue, and increase the profit margin (Steven & Brito, 2016). Some of the supply chain leaders saw the untapped emerging market potentials as a breeding ground for business growth opportunities (Alkire, 2014). Hence, some of the Western supply chain leaders used the emerging market potentials as the justification to participate in the global business entry (Alkire, 2014). Chen (2016) asserted that the Western leaders who penetrated the emerging market region aim to use the market presence to facilitate value creation through diverse creativity and cross-cultural collaboration. Contrarily, Steven and Brito (2016) contended that Western leaders penetrated the emerging market to take advantage of low-cost labor, reduced business tax, and facilitate the use of economies of scale to achieve sustained business growth and competitive advantage. Asgary and Li (2016) and Wolf (2014) cautioned that the offshoring and outsourcing of some supply

chain functions to the emerging market add complexities resulting in operational inefficiencies.

Chowhan, Pries, and Mann (2017) stated that while gaining global presence might benefit some Western supply chain leaders, global market presences also means exposure to additional competitors ready to compete for the market share. Jaeger, Kim, and Butt (2016) claimed that sociocultural, competition for market share, innovation evolution, strive to sustain profit margin, as well as social, environment, economic sustainability, and consumer pressure are the main driving factors of operational inefficiencies. To respond to the business challenges, some global supply chain leaders employed a system-thinking strategy to re-evaluate their value propositions (Fischer & Montalbano, 2014). The value proposition includes the plan to leverage the collective strengths of the diverse human capital across the supply chain network partners to transform the business challenges into opportunities (Fischer & Montalbano, 2014). Bansal and Agarwal (2015) suggested for supply chain leaders to influence a positive cultural change and install operational consistency by implementing an IT enterprise system to improve effective network partner collaboration.

Information Technology Economy

The supply chain organizations' human capital is the leading source of continued innovation, business growth, and competitive advantage (Fischer & Montalbano, 2014). However, the emergence of IT infrastructures has not just changed the business landscape and the human capital mindset; the IT-related initiatives have also changed the rules of

market competition (Chowhan et al., 2017). Li, Liu, Belitski, Ghobadian, and O'regan (2016) stated that staying competitive in the face of digital economy requires supply chain leaders to evolve with the evolution of IT-related infrastructures. The consumer demand transformation is following the digital economy evolution which is the key driving force behind the leaders' quest to gain access to the global market, forge relationships with global suppliers, manufacturers, and gain new customers (Schoemaker & Tetlock, 2017; Vatamanescu, Nistoreanu, & Mitan, 2017). Schoemaker and Tetlock (2017) asserted that some supply chain leaders are strategically taking advantage of the advent of IT-enabled infrastructures to outperform their competitors. Nguyen (2017) noted that successful supply chain leaders use IT-enabled systems to reduce operational waste caused by bullwhip effect triggers and improve the end-to-end process to gain a competitive advantage. Vatamanescu et al. (2017) expressed that consumers gained buying power because of the multiple digital product options available in the market, which exacerbated the rivalry competition. Li et al. added that the IT-related initiatives exponentially extended the boundaries of engagement, collaboration, and innovation. Maffey, Homans, Banks, and Arts (2015) cautioned that the adverse implication of digital technology market transformation is the effect on supply chain operation. Foerstl et al. (2015) asserted that part of the adverse implications relates to the challenges associated with global network partner engagements and communication. Alkire (2014) suggested for supply chain leaders to use the IT-enabled infrastructure to reduce operational waste and optimize the processes to gain competitive advantage.

Global supply chain leaders need to use economies of scale as the effective strategy to reduce operational cost (Li et al., 2016). Park (2017) asserted that leaders use the IT-enabled infrastructure to promote significant operational cost structural changes, as well as disrupt the digital market to influence a positive social change. With IT systems, the supply chain leaders can use global network formation, collaboration, and co-creation to gain competitive advantage (Park, 2017; Wang & Ran, 2018). Kache and Seuring (2017) emphasized the importance of using IT-enabled infrastructure to manage supply chain network's Big Data Analytics from a corporate context. Botham, Arribere, Brubaker, and Beier (2017) noted that the use of IT-enabled systems would help to improve operational performance, minimize the gap in information sharing, and reduce the bullwhip effect. Effective supply chain leaders use IT systems to provide visibility to minimize the overuse of employees, improve productivity, and sustain organizational effectiveness (Hong, Lu, & Zheng, 2017). Other researchers affirmed that most supply chain leaders already use IT-enabled infrastructures to simplify data collection, storage, and analysis to improve operational performance (Bonnín-Roca, Vaishnav, Mendonça, & Morgan, 2017; Ransbotham & Kiron, 2017).

Chowhan et al. (2017) added that the supply chain leaders also employ IT-enabled infrastructures to innovate to improve the standard of living through value creation. The standard of living improvement stems from the use of IT-enabled infrastructure to create employment opportunities for socioeconomic groups (Priyadarshini, Kumar, & Jha, 2017). Chowhan et al. (2017) noted a link between supply chain human capital and

innovation outcome. Baciu, Opre, and Riley (2016) credited humankind for taking advantage of the advent of IT products such as automated systems and artificial intelligence to apply creative thinking to various aspects of innovation. Schoemaker and Tetlock (2017) acknowledged that some supply chain leaders authorized the use of electronic IT products such as personal computers to facilitate operational cost reduction, increase economies of scale that influences sustained competitive advantage.

Part of the operational cost reduction include implementing a faster information sharing system, which the network partners can use to achieve effective collaboration with a simple click of the computer mouse (Schoemaker & Tetlock, 2017). Baciu et al. (2016) affirmed that supply chain leaders use the IT-enabled systems to facilitate global communication through text messaging, e-mail exchange, and video conferences. Some researchers also illuminated the need for leaders to authorize the implementation of enterprise resource planning (ERP) infrastructure (Bansal & Agarwal, 2015; Hoermann, Hlavka, Schermann, & Krcmar, 2015). The assertion is that the network partners can use the ERP system as the strategy to digitalize the supply chain operational processes (Hwang & Min, 2015; Kharuddin, Foong, & Senik, 2015; Saade & Nijher, 2016; Seethamraju, 2015). Hwang and Min (2015) affirmed that leaders could use ERP systems to enable operational process replication across the supply chain network, improve consistency which, if tightly integrated into the system, prevents fallback to old habits and influence a system-level cultural change (Hwang & Min, 2015). Qureshi and Abdulkhalaq (2015) cautioned that poor implementation of IT enterprise software

systems could result in an erosion of competitive advantage making it possible for competitors to gain a more significant share of the market.

Equally important is that leaders can use ERP systems to centralize and standardize fragmented, inefficient disparate systems and enforce discipline into operational processes (Hwang & Min, 2015; Qureshi & Abdulkhalaq, 2015; Saade & Nijher, 2016). Seethamraju (2015) noted that the switching cost of the ERP systems was a limiter for some supply chain organizations. Hwang and Min (2015) suggested for the cost-restricted supply chain leaders to authorize the use of IT-enable systems to integrate only the critical operational processes such as inventory, production, order management, and financial reporting. Ponte, Fernández, Rosillo, Parreño, and García (2016), in agreement with Hwang and Min, confirmed that leaders could use information sharing and synchronized decisions to facilitate competitive advantage. Nevertheless, Ponte et al. (2016) stressed that leaders use process integration to sustain competitive advantage. Other researchers acknowledged that leaders could achieve sustained competitive advantage by using IT-enabled systems to manage their supply chain operational activities (Hwang & Min, 2015; Kharuddin et al., 2015; Saade & Nijher, 2016). The vital operational features include production processes, resource functionality, and cross-cultural and network partner collaboration (Bansal & Agarwal, 2015; Hoermann et al., 2015; Hwang & Min, 2015; Kharuddin et al., 2015; Saade & Nijher, 2016; Seethamraju, 2015). Pataraarechachai and Imsuwan (2017) noted that leaders use collaboration as a critical strategy to mitigate the bullwhip effect. Al-Zu'bi (2016) and Qureshi and

Abdulkhalaq (2015) insisted that for the integration to effect positive change, the leaders need to balance the level of system integration that they authorize to the strategic system thinking of the corporation.

Environmental Effect on Global Supply Chain Sustainability

The leaders must make the physical environment of the supply chain operations a part of the critical components of the corporate system-thinking strategy because the nature of the environmental climate could affect the operational performance (Choi, 2016; Mittal & Elias, 2016; Zhu et al., 2016). Zhu et al. (2016) stated that a change in the environmental climate could make or break business sustainability. For instance, a natural disaster occurrence could constrain component supply thereby disrupting supply chain operational activities, increase manufacturing cost, customer dissatisfaction, and reduction in revenue generation (Antai, Mutshinda, & Owusu, 2015; Xu, Zhuang, & Liu, 2016). Kato (2016) and Putranto and Susanto (2017) noted that some Western corporation leaders operate a significant portion of their supply chain functions in the natural disaster-prone regions to explore the untapped market potentials.

The Western corporate leaders penetrating the emerging markets aim to gain global presences, as well as get closer to the worldwide component suppliers, product manufacturers, and gain access to new markets while taking advantage of the tax break and inexpensive labor (Toor, 2014). However, the leaders sometimes experience challenges associated with supply chain complexities exacerbated by operational disruptions, cultural differences, and lack of enforceable social responsibility policies,

and government regulations (Jaeger et al., 2016; Mattera & Baena, 2015). To mitigate the adverse effect of cultural differences, some Western supply chain leaders choose to adopt the culture of the environment of their business operation (Mittal & Elias, 2016). Meanwhile, adopting the culture of some of the emerging market countries could inadvertently exert unethical action that may lead to adverse financial consequences (Tukuta & Saruchera, 2015). Asgary and Li (2016) cautioned that part of some of the emerging market countries business practices might include bribery. Bribery is an unethical business practice in Western countries (Asgary & Li, 2016). Hence, the adoption of the partner's culture that consists of an unethical business practice could result in adverse direct and indirect consequences on the organization's corporate brand and revenue generation (Asgary & Li, 2016).

Although constrained by environmental forces, leaders use network partners' tools, techniques, and human resource competencies to respond to the internal and external forces, which, in turn, produce products that influence a positive social change (Choi, 2016; Wiengarten, Lo, & Lam, 2017). Therefore, the global supply chain network with sustainable initiatives integrated into their system-level strategies gain better exposure to innovation opportunities (Wiengarten et al., 2017). Alternatively, the quality of the products determines the competency level of the leaders' system thinking, which directly or indirectly affect the overall supply chain operational performance (Plugge et al., 2016). Al-Zu'bi (2016) noted that the competence level of system-thinking approach to which leaders employs to respond to business challenges, sustain the current market

position, and compete in the new market have tremendous implications on the organization's short-term and long-term business performances. Maletič et al. (2015b) affirmed that the supply chain leaders with sustainable integrated systems could gain better exposure to new opportunities compared to their opponents.

The assertion is that consumers tend to use demand-driven innovation and product development opportunities to patronize the supply chain organizations that demonstrated sustained socially responsible business practices (Maletič et al., 2015b). Khojastehpour and Johns (2014) contended that differences exist in the rate at which the Western countries adopt corporate social responsibilities compared to the emerging market countries rate of adoption. Mattera and Baena (2015) concurred by stating that imposed corporate social responsibility can adversely affect local businesses in the emerging market regions. Ali, Pedram, Nukman, and Sorooshian (2017) postulated that, rather than imposing corporate social responsibility on emerging market countries, leaders should utilize their corporate-level monitoring system to influence their network partners' practices and ethical behavior. Global supply chain leaders should not ignore consumer expectation of them to integrate corporate level socially responsible behavior initiatives as part of the supply chain long-term operational imperatives (Neumüller, Lasch, & Kellner, 2016; Yawar & Seuring, 2017).

The consumers, stakeholders, and shareholders in a global system expect global supply chain leaders to respond to the effect of the demographics, social, and cultural changes in the countries that they operate their businesses as part of their social and

environmental responsibilities (Choi, 2016; Mittal & Elias, 2016). Because of global warming awareness, many countries implemented legislation to address air quality, water pollution, and the cleanup of contaminated sites (Hsu et al., 2016). Researchers suggested for leaders to use the international standards on quality assurance management to assess the quality of their internal operational environment (Dellana & Kros, 2014; Molnar, Nandhakumar, & Stacey, 2017; Păunescu, Argatu, & Lungu, 2018; Sharma & Modgil, 2015). However, Radej, Drnovšek, and Begeš (2017) argued that the assessment of supply chain operational quality should not be isolated to the primary organization but rather to the entire partners of the supply chain network. The assertion is that network partners' unethical actions, or decisions can damage the primary organization's brand reputation (Asgary & Li, 2016; Khojastehpour & Johns, 2014).

Foerstl et al. (2015) noted that leaders could implement sustainable business practices into their system-level thinking to mitigate the effect of external pressures and align with the government regulations. Yilmaz et al. (2016) hypothesized that leaders could use the collaborative advantage to influence improved operational process efficiencies and enable product development flexibility. Additionally, leaders can leverage both internal and external network partner's resources to exert speed, quality, and economies of scale to innovative products and services on time to meet market demand (Yilmaz et al., 2016). Foerstl et al. affirmed that by removing waste from the supply chain collaboration, innovation, process, and leveraging the network partners' sustainability initiatives, organizations could improve their economies of scale while

conserving other natural resources. Raza and Kilbourn (2017) noted that an effective partner collaboration strategy could lead to improved operational performance. Yilmaz et al. (2016) added that mitigating the consumer demand fluctuation requires effective collaboration and synchronization of network partners' operational processes, alignment of leadership visions to consumer demand, and effective communication with customers.

Transition and Summary

Section 1 contains the foundation for the study. I used section one to highlight the background of the research relevant to the strategies supply chain leaders used to reduce bullwhip effect in the electronic component supply chain. I identified and discussed the business problem and the purpose of the study. I explained how leaders might use the findings to influence positive social change and improve business practices. Additionally, I discussed the assumptions, limitations, and delimitation of the study. Finally, I used literature review to illustrate the body of knowledge from existing literature on the bullwhip effect phenomenon. Section 2 contains detailed information about the research process, my role as the researcher, data collection, data analysis, maintaining ethical standards, and ensuring dependability, credibility, and confirmability. In Section 3, I discussed and presented the findings of this study. The research outcome included the discussion of the interview proceedings, data analysis, and the identified themes and partners used to address the central research question. I proposed recommendations for IT supply chain leaders and practitioners relevant to the effective strategy to reduce the bullwhip effect in the electronic component supply chain. Additionally, I presented the

application of the study, as well as suggest further research study opportunities and provide a concluding statement.

Section 2: The Project

In Section 2, I provide an in-depth explanation of the research method and design I used to explore the strategies that leaders use to reduce the bullwhip effect on their electronic component supply chains. I highlight the purpose of the study and discuss the role of a qualitative researcher. In addition, I explain the techniques I used to identify potential research participants and the sampling method. In the section, I also discuss how I ensured adherence to ethical standards, and I explain the data collection, organization, and analysis techniques used in the study. Section 2 conclude with a discussion on how I ensured dependability, credibility, and confirmability of the data and the findings of this study.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that some IT supply chain leaders use to reduce the bullwhip effect on their supply chain network. The targeted population consisted of 15 supply chain leaders of five IT companies located in Houston, Texas, who have successfully implemented strategies to reduce costs from the bullwhip effect on their supply chain network. The implication for social change includes improving environmental sustainability through reductions in excess and obsolete inventories and the consumption of storage-related resources, transportation fuels, and other natural resources.

Role of the Researcher

Qualitative researchers should demonstrate their capabilities to address the challenges associated with social science research (Houghton, Murphy, Shaw, & Casey, 2015). Muganga (2015) recommended that qualitative researchers outline the critical activities they must undertake to demonstrate their understanding of their role in qualitative research. Valipoor and Pati (2016) noted that the primary function of a qualitative researcher is to serve as the primary data collection instrument. I served as the data collection instrument by collecting data from leaders who have successfully reduced the bullwhip effect in their electronic component supply chain. I exerted multiple strategies to manage known constraints associated with qualitative case-study research. Part of the strategy I employed was to leverage my familiarity with my research topic and the geographic location of the study to address risks associated with conducting multiple case study. In Section 2, I discuss my plan to mitigate risks related to data collection and conflict of interest. I also discuss the strategy that I used to prepare for my research participant interviews, the interview protocol, and the interview questions. More importantly, I address the strategy I used to conduct ethical research and to bracket my own lens to mitigate bias. I employed the following strategies to lessen potential bias: (a) epoché and a reflective journal approach, (b) multiple sources of evidence, (c) data saturation, and (d) member checking.

Qualitative researchers typically possess a high degree of familiarity with their topic of interest (Bhatti, Janjua, Akhtar, & Azad, 2014; Noble & Smith, 2015). I have 20

years of professional experience in the information and technology industry. I spent the first 3 years of my career as a research and development engineer working on silicon wafer fabrication. I worked on developing new metal deposition and metal etch processes for 8-inch wafers. For 17 years, I worked on supply chain-related activities including procurement, strategy and planning, and program management initiatives. Researchers familiarize themselves with the geographic area of the study (Killawi et al., 2014). I have resided in Houston, Texas, from 2010-2018; therefore, I am familiar with the geographic area of my research study.

As the data collection instrument for a qualitative research study, the researcher needs to demonstrate the ability to mitigate any conflict of interest that might arise when conducting social science research (Cairney & St. Denny, 2015; Mukhopadhyay & Gupta, 2014). Researchers need to reveal self-characteristics relevant to research participants along with their assumptions, potential bias, and experiences to demonstrate their ability to conduct ethical research (Unkovic, Sen, & Quinn, 2016). To mitigate potential conflicts of interest, I did not select friends or professional colleagues to participate in the study. I chose participants who met the criteria for my research study. The research participants consisted of IT leaders in Houston, Texas, who implemented strategies to reduce the bullwhip effect on their electronic component supply chain. The selected leaders possessed the knowledge and experience implementing strategies that helped to reduce the bullwhip effect. In addition, the participants had the capacity to influence positive operational change within their organization.

Qualitative researchers are responsible for recruiting research participants who do not possess a current prior personal or professional relationship with the researcher (Killawi et al., 2014). I recruited research participants whom I did not have a personal or professional relationship with to participate in my study. Researchers need to analyze and interpret the collected data to understand the meaning from the participants' perspectives (Houghton et al., 2015; Muganga, 2015; Valipoor & Pati, 2016). I used interview questions (see Appendix A) to collect research data from the participants during semistructured face-to-face and Skype interview sessions. I used qualitative research software to analyze participants' data to identify themes and codes that facilitated the interpretation of the collected data. Analysis of the interpreted data allowed me to understand the meaning of the study phenomenon from the participants' perspectives.

Adequate preparation is a valid method to increase effectiveness and efficient use of research participants' time during the interviews (Alby & Fatigante, 2014; Dikko, 2016; Jamshed, 2014). I used the interview preparation phase to identify and document the procedure I would follow while interviewing research participants. One of my interview preparation activities was to use the informed consent form to obtain agreement from the selected participants to engage in the study.

Qualitative researchers use the interview protocol as a technique to conduct consistent interviews, improve interview retinue, reduce data collection bias, and capture the participants' thoughts when making complex decisions (Alby & Fatigante, 2014; Haahr, Norlyk, & Hall, 2014; Peters & Halcomb, 2015). I used an interview protocol (see

Appendix B) to ensure consistency, and reduce discrepancies and oversights before, during, and after the interviews. Following the interview protocol, I asked each leader the same open-ended questions (see Appendix A) in the same order while using the bracketing technique to mitigate bias.

Qualitative researchers need to report all data collected from the participants without bias (Naci, Dias, & Ades, 2014; Toews et al., 2017; Unkovic et al., 2016). Castillo-Montoya (2016) noted that discrepancies and oversights could occur while interviewing research participants. To ensure that the data collected aligned with the research problem, I aligned the interview questions (see Appendix A) to the primary research question to ensure that the participants' responses addressed the research topic. I used probing questions to gain clarification as needed to understand the information shared from the participants' perspectives. I used my interview protocol to facilitate the interviews with all the participants. I reported all collected data to enhance the reliability and validity of my research outcome.

Qualitative researchers are responsible for protecting their research participants from harm and safeguarding their data and identities as well as their organization's identifiable information (Boucher et al., 2017; Peters, 2014; Sorsa, Kiikkala, & Åstedt-Kurki, 2015). Researchers leverage the Belmont report ethical principles to protect humans participating in social science research (Belmont Report, 1979). The principles include respect for persons, beneficence, and justice (Belmont Report, 1979). Respect for persons is a concept researchers use to protect potential participants with diminished

autonomy. Researchers address beneficence to reduce the harm that might affect the research participants while maximizing the benefit of the study outcome. Justice is the constraint that researchers use to prevent from exploiting vulnerable research study participants. Qualitative researchers need to abide by the Belmont report core principles of research ethics (Bracken-Roche, Bell, Macdonald, & Racine, 2017; Judkins-Cohn, Kielwasser-Withrow, Owen, & Ward, 2014; Yearby, 2016). I followed the Belmont report ethical principles throughout my research study. Additionally, I adhered to the Walden University's guideline relevant to a research study that involves human participants. I used the informed consent form to ensure that the selected participants understand their rights, potential benefits, and risks associated with the study. Participation in my research study was voluntary. I informed the participants that they may withdraw from participation in this study at any time. I used a coding technique to protect the participants' identities, privacy, and organizational information.

Researchers use epoché approach to set aside preconceptions, reduce error, and accept participants' data in its form (Sorsa et al., 2015). I used the epoché approach to set aside bias that might stem from my professional experience. Researchers are to detach from their personal views, beliefs, and ethics during data collection, analysis, and interpretation (Sarma, 2015; Toews et al., 2016). Applebaum (2014) noted the value of using a reflective journal to reduce bias. I used reflective journal throughout the data collection phase to keep a record of the interview activities and to minimize bias. Qualitative researchers employ multiple sources of evidence to reduce bias, inspire

transparency, ensure reliability, and validity of the research outcome (Leung, 2015; Noble & Smith, 2015; Yin, 2017). I collected my research data from multiples sources. I used 30-45 minutes face-to-face and Skype interviews to obtain information-rich data from the participants. I reviewed publicly available documents relevant to the strategies the leaders used to reduce the bullwhip effect. I kept a reflective journal throughout the data collection phase.

Part of qualitative researcher's responsibility is to attain data saturation (Fusch & Ness, 2015). Researchers use data saturation to demonstrate rigor, enhance transparency, validity, and dependability of the research outcome (Fusch & Ness, 2015; Hancock, Amankwaa, Revell, & Mueller, 2016; Widodo, 2014). To achieve data saturation, I used multiple techniques, such as participants' interviews, company documents, and reflective journals, to collect my research data. I used methodological triangulation to compare data collected from different techniques. I used the coding technique to identify and create themes until further coding and theme creation was no longer reasonable. I conducted member checking with each interview participant to add rigor and enhance the reliability of the research outcome.

Qualitative researchers are to allow the understanding of the meaning of the participant's data to support the development of new knowledge (Berger, 2015; Birchall, 2014; Clark & Zygmunt, 2014; Leichsenring et al., 2017; Leung, 2015; Noble & Smith, 2015). During the data collection and analysis phase, I used my reflective journal to mitigate the urge of leaning toward my personal view. Using the audio recording device

for the interviews, I ensured verbatim interpretation of the participants' information. By employing member checking strategy, I engaged each participant to review, correct, and approve the interpreted information before reporting the outcome of my research study.

Participants

Selecting capable research participants is vital when conducting social science research (Killawi et al., 2014; Park & Sha, 2014). The eligible participants for my research study are IT supply chain leaders who have successfully implemented strategies to reduce costs from the bullwhip effect on their supply chain network. IT supply chain leaders are influential and hold power to authorize cross-functional, organizational, and network partners operational processes change (De Abreu & Alcântara, 2015; Singhry, 2015; Zhang, Van Donk, & Van, 2016). The eligible criteria to participate in my research study are (a) supply chain leaders, (b) employed by IT companies in Houston, Texas, and (c) who successfully implemented strategies to reduce the bullwhip effect on their electronic component supply chain. Research participants serve as the information-rich data source for the qualitative research study. The qualitative researcher needs to purposefully select participants that possess appropriate experience and knowledge about the central research question (Asiamah, Mensah, & Oteng-Abayie, 2017; Boddy, 2016; Fok, Henry, & Allen, 2015; Fusch & Ness, 2015; Kline, 2017).

I selected participants possessing the capacity to provide information-rich data to facilitate the understanding of the strategies some IT supply chain leaders used to reduce the bullwhip effect in their electronic component supply chain. Researchers use social

media, public database, and directories to gain access to prospective research participants (Maramwidze-Merrison, 2016; Peters, 2014; Philbin & Kennedy, 2014). I followed the step-by-step process outlined below to gain access to prospective participants. I acquired the Walden University's IRB approval relevant to social science research ethical requirements. I used the Houston Texas Chamber of Commerce business directory and trade publications, such as the Gartner Supply Chain Top 25 and Supply Chain World to identify eligible IT supply chain companies in Houston, Texas. I used e-mail to introduce myself as well as the research topic to the participants. Part of my e-mail content was to inform the prospective participants that I recognized him or her as the supply chain leader with critical information needed to support the execution of my research study. I used e-mail to send an invitation letter (see Appendix C) to prospective participants to ask for their participation in this research study. I requested a brief phone or face-to-face discussion for a formal introduction. I used the informed consent form to highlight the research benefits, risks, and plans to manage confidential information.

Social science research involves personal interactions with research participants. Researcher and participant's social interaction is a scenario that enables qualitative researchers to establish and secure trust with selected participants (Mondada, 2014). Building relationship with research participants promotes support leading to positive qualitative research study outcome (McDermid, Peters, Jackson, & Daly, 2014; Van Praag & Sanchez, 2015; Wall, 2015). I sustained the professional relationship with each

participant through regular e-mail and phone calls to discuss progress. Additionally, I used e-mail or phone calls to provide regular research study progress updates.

Qualitative researchers use interview sessions to collect research data (Mondada, 2014). During the interview preparation phase, I aligned my interview questions (see Appendix A) to the central research question of the study. I explained the research participation requirements to all participants. Researchers need to select participants with adequate experience to provide information-rich data that would influence the understanding of the phenomenon under study (Hoyland, Hollund, & Olsen, 2015; Park & Sha, 2014). I conducted 30-45 minutes semistructured interviews with the selected IT supply chain leaders. I used my interview protocol (see Appendix B) to conduct each interview and acquire data for my research study.

Research Method and Design

Researchers can exert a mix of quantitative and qualitative research methods to examine a social science phenomenon. Alternatively, researchers can independently conduct quantitative or qualitative research to address a social science phenomenon (Birchall, 2014; Felix Octavio, 2016; Wall, 2015). I discussed each research method and design, providing justification for my chosen method and design as well as the rationale for rejecting other methods and designs.

Research Method

I considered the three research methods: qualitative, quantitative, and mixed. I decided to use the qualitative research method to explore the strategies IT supply chain

leaders used to reduce bullwhip effect in their electronic component supply chain. The justification for using the qualitative method follows below. Researchers use the qualitative method to explore complex social science phenomenon requiring diverse perspectives from knowledgeable participants to address the research topic (Birchall, 2014; Danielsson & Rosberg, 2015; Yin, 2017). Spillman (2014) noted that qualitative research method aligns with the epistemological assumption that everyday occurrences are complex, linked, and variable are unable to separate the occurrences. The qualitative research method was the appropriate technique to conduct my research study because of the complex nature of the research topic.

Qualitative researchers use the central question of their research study topic to develop open-ended questions. Researchers use the open-ended questions to engage multiple participants with different knowledge of the research topic (Birchall, 2014; Spillman, 2014; Yin, 2017). I used open-ended interview questions (see Appendix A) to interview participants with varying knowledge of the research topic. With the open-ended questions, researchers can acquire information-rich data from multiple participants based on the participant's experiences of the phenomenon under study (Birchall, 2014; Li et al., 2014; Rafique & Hunt, 2015). I used the central research question of my research to develop the open-ended questions that I used to conduct participant interviews.

Researchers use qualitative research method to acquire information-rich data. Qualitative researchers collect data through (a) participants interviews, (b) observations documented on a reflective journal, and (c) document review (Elman, Kapiszewski, &

Kirilova, 2015; Palinkas, et al., 2015; Rudnick, 2014). I used interviews to collect information-rich data from my research participants, reviewed company documents related to strategies used to reduce the bullwhip effect, and used a reflective journal to document my observations. Researchers use the analysis of the collected data to discover and create themes and patterns (Baş & Sağırlı, 2017; Colorafi & Evans, 2016; Houghton et al., 2015). I coded my participants' data to create themes and patterns. Researchers use themes and patterns to facilitate the understanding of the complex phenomenon and address the central research question of the research topic (Colorafi & Evans, 2016; Cope, Jones, & Hendricks, 2015; Vohra, 2014). I used themes and patterns to facilitate the understanding of my research data from the participant's perspectives. The qualitative research method was suitable for this research study because I needed to collect information-rich data using an open dialog with participants to answer the research question.

Quantitative researchers rely on variable strengths to quantify a phenomenon by generating numerical data to create mathematical models or validate existing theories (Michaelson, McKerron, & Davison, 2015; Röing & Sanner, 2015; Siddiqui & Fitzgerald, 2014). My research topic does not require the use of variables to answer the central research question. Researchers use structured techniques and closed-ended questions to collect data for their research studies (Baş & Sağırlı, 2017; Doody & Bailey, 2016; Tse et al., 2016). I used semistructured interviews and open-ended questions to collect data for my research study. Statistical testing is one of the primary data analysis

technique that researchers use to analyze their quantitative research data (Concato & Hartigan, 2016; Counsell & Harlow, 2017; Garrocho-Rangel, Ruiz-Rodríguez, & Pozos-Guillén, 2017). I used a coding technique to create themes and patterns for my research study that does not include statistical testing of data.

Researchers examine relationships between variables through hypothesis testing of specified constructs to develop a theory about the phenomenon under study (Goertzen, 2017; Tse et al., 2016; Quan, Pluye, Bujold, & Wassef, 2017). I did not examine variable relationship for my research study. The data collection instrument plays a significant role relevant to the reliability of the outcome of a quantitative research study (Green et al., 2015; Goertzen, 2017; Kaur, 2016; Zhang & Watanabe-Galloway, 2014). I served as the data collection instrument for my research study. The reliability of my research study outcome depended on the applied rigor. I added rigor by using multiple sources to collect data, ensure data saturation, use triangulation as part of my data analysis, and use member checking to validate my transcribed data. After consideration of the quantitative research method attributes, I confirmed that the qualitative research method was not appropriate for my research study because the central research question of my research does not require statistical data to test the hypothesis and I did not examine the relationship between variables.

The quantitative and qualitative research methods are two independent worldviews that are not mutually exclusive. However, researchers can choose to mix both techniques to explore and evaluate a correlation between observed variance and the

attributes of a social science phenomenon (Halcomb & Hickman, 2015; Holt & Goulding, 2014; Zhang & Watanabe-Galloway, 2014). I explored the strategies supply chain leaders used to reduce bullwhip effect in their electronic component supply chain. Because the qualitative and quantitative worldviews are not mutually exclusive, researchers can sequentially use both methods in a single study to explore and evaluate a complex phenomenon that would not have otherwise addressed by a single research method (Felix Octavio, 2016; Li et al., 2014; Michaelson et al., 2015). I used one research method to address the central question of my research topic.

Mixed-method research requires significant time for data collection, hypothesis testing, analysis, and interpretation of the research data (Abro, Khurshid, & Aamir, 2015; Katz, Vandermause, McPherson, & Barbosa-Leiker, 2016; Kaur, 2016). I used an interview protocol (see Appendix B) to facilitate data collection for my research study. The duration of mixed method coupled with financial implication makes the use of mixed-method research study unattractive to some novice researchers (Green et al., 2015; Katz et al., 2016; Kaur, 2016). Researchers use the research question of a mixed-method study to decide whether to initiate an investigation with a qualitative or a quantitative method. In either case, mixed-method researchers use the outcome of the first research study as the input to the subsequent research study (Abro et al., 2015; Spillman, 2014). Mixed-method researchers report the outcome of each study independently, and then use comparison technique to integrate and report the results of both studies (Gobo, 2015; Green et al., 2015; Katz et al., 2016). I reported only the outcome of the research method

that I chose to use to explore the strategies supply chain leaders used to reduce the bullwhip effect in their electronic component supply chain. After consideration of the mixed-method research characteristics, I decided that the mixed-method research was not appropriate for my research study because I did not test hypotheses that were a quantitative portion of a mixed research method study.

Research Design

Qualitative researchers typically use four research designs to explore a social science phenomenon. The four research designs are (a) phenomenology, (b) ethnography, (c) narrative inquiry, and (d) case study (Mukhopadhyay & Gupta, 2014; Quan et al., 2017; Ridder, 2017). I discussed each research design, providing justification for my chosen design as well as the rationale for rejecting the remaining designs. Case study researchers aim to explore the individual experience of a phenomenon in great depth within the natural setting where the event occurred (Yin, 2017). Researchers use recorded semistructured interviews, direct participants observations, reflective journal, and document review to collect data (George, Mehra, Scott, & Sriram, 2015; Kantola & Saari, 2014). Case study researchers can employ various qualitative data analysis techniques to syntheses, code, and create common themes and patterns to facilitate the interpretation and in-depth description of the experiences from the participants' perspective (Colorafi & Evans, 2016; Evers, 2016; Onwuegbuzie & Weinbaum, 2017). Case study researchers possess background knowledge of their research topics, hence, use rigor to ensure reliability and validity of the research outcome (Colorafi & Evans, 2016; Hadi & José

Closs, 2016; Olson, McAllister, Grinnell, Walters, & Appunn, 2016; Petrescu & Lauer, 2017).

To add rigor, researchers use bracketing to set aside their previous experiences about the phenomenon. Researchers need to keep an open mind to allow the use of data to uncover new knowledge about the topic under study. Case study researchers are to continue data collection and analysis process going until he or she can no longer create new themes and patterns (Newman, Hitchcock, & Nastasi, 2017; Skea, 2016; Snelgrove, 2014). I explored the existing strategies supply chain leaders in their organizational setting used to reduce the bullwhip effect; therefore, a case study was the research design that was appropriate for my research study. Qualitative researchers use phenomenological research design to describe the uniqueness of lived experiences through the participant's interpretation of the phenomenon (Matua, 2015; Sloan & Bowe, 2014; Van Manen, 2017). Researchers use structured interviews, written words, direct observation, and recorded audios to collect data that would address the research topic (Bjørkløf, Kirkevold, Engedal, Selbæk, & Helvik, 2015; Braun, Schell, Siegfried, Müller, & Ried, 2014; Danielsson & Rosberg, 2015). Researchers use classification and ranking techniques to analyze phenomenological research data to identify themes to facilitate the explanation of the findings (Alase, 2017; Matua, 2015; Matua & Van, 2015). I did not explore my research participants' lived experiences.

Ethnographic researchers aim to explore how culture influences people behavior and values (Cordoba-Pachon & Loureiro-Koechlin, 2015; Draper, 2015; Norman &

Verganti, 2014; Tunçalp & Lê, 2014). Researchers employ ethnographic research design to immerse themselves in a society where a group of people shares common culture, values, and beliefs. Researchers aim to discover how society characteristics affect the behavior of the people within the culture (Draper, 2015; Leslie, Paradis, Gropper, Reeves, & Kitto, 2014; Molloy, Walker, & Lakeman, 2017). Ethnographic researchers use structured or unstructured interviews, observation, and collection of documents to gather data for the research study (Bikker et al., 2017; Draper, 2015; Leslie et al., 2014). Using a sequence of events, Ethnographic researchers can analyze the research data by identifying the fundamental drivers of the cultural beliefs to describe the culture (Bikker et al., 2017; Iloh & Tierney, 2014; Molloy et al., 2017; Murchison & Coats, 2015; Wall, 2015;). I did not study a group's culture or values.

Narrative researchers aim to explore life experiences of individuals through the retelling of peoples' stories (Carmel-Gilfilen & Portillo, 2016; Joyce, 2015; Shedrow, 2017). Researchers use personal storytelling of life experiences, interviews, reflective journal, autobiographies, written letters, pictures, school records, newsletters, and audio recordings to collect data for their research studies (Berry, 2016; Chakraborty, 2017; Wall, 2015). Researchers employ multiple techniques to analyze narrative research data to identify direct quotes, paraphrase common ideas, identify themes and patterns, and use member checking to validate the interpreted data (Corbally & O'Neill, 2014; De Loo, Cooper, & Manochin, 2015; Wall, 2015). Researchers use the interpreted research data to construct narratives of how individuals create meaning in their lives (Jagals & Van, 2016;

Wall, 2015; Whiffin, Bailey, Ellis-Hill, & Jarrett, 2014). The narrative inquiry was not appropriate for my research study because I did not study individual's life experiences through the retelling of participants' stories.

Researchers conducting a qualitative case study must reach data saturation (Fusch & Ness, 2015; Morse, 2015; Yin, 2015). To reach data saturation, researchers must demonstrate that they have gathered enough information-rich data from multiple sources to facilitate replication of the study (Boddy, 2016; Fusch & Ness, 2015; Morse, 2015; Widodo, 2014). Researchers should collect data until no new themes and patterns emerge, additional coding of data is no longer possible, and further data collection no longer results in new information (Boddy, 2016; Fusch & Ness, 2015; Morse, 2015; Roy, Zvonkovic, Goldberg, Sharp, & LaRossa, 2015; Widodo, 2014). The use of an interview protocol to ensure consistency among all the interviews, member checking, and methodological triangulation of multiple sources of data are the means by which researchers attain data saturation (Fusch & Ness, 2015; Yin, 2015). I used an interview protocol to ensure consistency among all the interviews (see Appendix B), engage the participants in member checking, and use methodological triangulation of multiple sources of data to reach data saturation. I continued data collection until no new patterns or themes emerged. I reached data saturation after the fifth interview because the data collected became repetitive, resulting in no new information.

Population and Sampling

Population

Qualitative researchers use various methods including interviews, observations, and document review to collect data for their studies (Emmel, 2015). However, obtaining information-rich data requires strategic selection of research location and participants from a population that meets the criteria for the research topic (Asiamah et al., 2017; Gentles, Charles, Ploeg, & McKibbon, 2015; Gheondea-Eladi, 2014). A population is a cluster of eligible research participants from which researchers could choose to use all members of the population or select a few members that possess the highest level of experience and knowledge about the research topic to support the study (Colombo, Froning, Garcìa, & Vandelli, 2016; Gheondea-Eladi, 2014). The IT supply chain leaders were the eligible population from which I selected a purposeful sample to participate in my study. The targeted population consists of 15 supply chain leaders in five IT companies located in Houston, Texas. Choosing accessible participants was critical to the success of a research study (Asiamah et al., 2017; Gentles et al., 2015; Gheondea-Eladi, 2014). I purposefully selected five leaders from the targeted population. Qualitative case study researchers use their central research question as the primary measure for selecting key participants from the eligible population that meets the criteria for the phenomenon under study (Colombo et al., 2016; Parker & Northcott, 2016). I used my central research question to align the selection of key participants to ensure that I selected only the participants that met the criteria for this research study. The requirements for this study

consist of leaders of IT supply chain organization in Houston, Texas who successfully implemented strategies to reduce the bullwhip effect on their electronic component supply chain.

Interview Setting

Equally important is the selection of interview location that would ease participants concerns for confidentiality, assure privacy, and promote participation (Dikko, 2016; Hawamdeh & Raigangar, 2014; Sorsa et al., 2015). The best interview setting is a quiet environment. Therefore, to ensure privacy, researchers could invite participants to meet at a neutral place near the participant's business location (Green et al., 2015). To ensure confidentiality, assure privacy, and promote participation, I invited the participants to meet at a neutral location close to their business site for the face-to-face the interviews, such as a private conference room in a public library. I conducted the telephone interviews from my home office with the participants who are unable to meet in person. Moreover, sample size influences the quality of data to be collected from the prospective participants (Asiamah et al., 2017; Fok et al., 2015; Kline, 2017). Therefore, the sampling of participants with information-rich data relevant to central research question drives the number of participants researchers could select to participant in a qualitative case study research.

Sampling

Sampling is the technique researchers exert to identify and select research participants that would provide information-rich data to address the phenomenon under

exploration (Dias, Wallgren, Wallgren, & Coelho, 2016; Gentles et al., 2015). Qualitative researchers employ various sampling techniques to acquire research participants. Purposive sampling is a nonprobability sampling technique that researchers use to select participants from a qualified population (Quinn & Halfacre, 2014; Waters, 2015). Researchers use purposive sampling to intentionally select specific participants from the qualified population that meet the eligibility requirements for their studies (Gentles et al., 2015; Kitheka, Baldwin, White, & Harding, 2016; Palinkas et al., 2015).

Some researchers argued that purposive sampling is not an accurate representation of research population (Colorafi & Evans, 2016; Gentles et al., 2015; Gentles, Charles, Nicholas, Ploeg, & McKibbon, 2016). Nevertheless, qualitative researchers consider purposive sampling a choice. The reason is that purposeful sampling technique facilitates the selection of available participants that possesses information-rich data capable of answering the central research question (Burford, Given, & Hider, 2015; Robert, 2015; Robinson, 2014; Roy et al., 2015). Since the primary goal of sampling was to identify research participants that would provide information-rich data to answer the central research question for the topic under study, a purposive sampling technique was the best fit for my research study. Therefore, I employed the purposive sampling technique to select leaders from the IT supply chain companies in Houston, Texas who possessed knowledge and experience in implementing strategies to reduce the bullwhip effect in the electronic component supply chain.

Sample Size

The gathering of information-rich data specific to the central research question is critical when conducting qualitative case study research (Asiamah et al., 2017; Fok et al., 2015; Kline, 2017). For a qualitative case study using purposive sampling, *information-rich* implies the quality of participants experience and knowledge relevant to the central research question. Thus, the participant's experience and knowledge was the most critical factor that drives sample size decision. For this reason, qualitative case study researchers use central research question as the guide to ensure the selection of acceptable sample size (Boddy, 2016; Fok et al., 2015; Fusch & Ness, 2015; Kline, 2017). The more experience and knowledge the selected participants possess, the lower the number of participants needed to conduct the study (Roy et al., 2015).

Bowman (2015) conducted qualitative case study research within manufacturing firm, using a sample size of four participants. Dey (2016) conducted a multiple case study of strategies to reduce supply chain disruptions, collecting interview data from four business leaders, one from each participating company. Layen-Layeni (2017) studied the phenomenon of strategies for minimizing defects in offshore-outsourced products within the IT industry, using two participants as the sample size. Based on the sample sizes used in similar research studies conducted by Bowman, Dey, and Layen-Layeni, five participants were an appropriate sample size for this study. I purposively chose a sample size of five supply chain leaders to gain a holistic view of the strategies leaders used to implement bullwhip effect reduction in the electronic component supply chain. The five

leaders consisted of two factory management partners, two electronic component suppliers, and one demand-planning partner. I contacted the selected leaders through e-mails to seek for their voluntary participation in the study. Prior to beginning the interviews, I obtained the participants' informed consent.

Data Saturation

Qualitative researchers use data saturation to promote transparency, content validity, quality, and trustworthiness of research outcome (Fusch & Ness, 2015; Hancock et al., 2016; Widodo, 2014). To reach data saturation, researchers must demonstrate that they have gathered enough information-rich data from multiple sources to facilitate replication of the study (Boddy, 2016; Fusch & Ness, 2015; Morse, 2015; Widodo, 2014). Researchers should collect data until no new themes and patterns emerge, additional coding of data is no longer possible, and further data collection no longer results in new information (Boddy, 2016; Fusch & Ness, 2015; Morse, 2015; Roy et al., 2015; Widodo, 2014). The use of an interview protocol to ensure consistency among all the interviews, member checking, and methodological triangulation of multiple sources of data are the means by which researchers attain data saturation (Fusch & Ness, 2015; Widodo, 2014; Yin, 2015). I used an interview protocol to ensure consistency among all the interviews (see Appendix B), engage the participants in member checking, and use methodological triangulation of multiple sources of data to reach data saturation. I continued data collection until no new patterns or themes emerged. I reached data

saturation after the fifth interview because the data collected became repetitive, resulting in no new information.

Ethical Research

Researchers use the informed consent form to disclose the nature of their studies, the execution process, outline the plans to protect participants from harm, and provide withdrawal instructions (Cugini, 2015; Judkins-Cohn et al., 2014). By analyzing the content of the informed consent form, participants can make sound decisions based on their own best interest before voluntarily providing informed consent to participate in a research study (Cugini, 2015; Judkins-Cohn et al., 2014). Prospective participants should possess the capacity to comprehend the research content, affirm their willingness to participate voluntarily, and use the informed consent form to provide their autonomous authorization (Bromley, Mikesell, Jones, & Khodyakov, 2015). Researchers use the informed consent process to offer the willing participants the opportunity to sign the voluntary agreement that would enable them to take part in the research study (Fusch & Ness, 2015; Haahr et al., 2014; Mondada, 2014). I sent an e-mail to the purposefully selected participants to invite them to participate in my research study (see Appendix C). I attached a copy of the informed consent form to the invitation e-mail. Participants provided informed consent by replying *I consent* to the e-mail containing the informed consent form. I obtained informed consent from participants prior to collecting data.

Participants have the autonomy to change their mind from participating in the study at any time. Therefore, researchers are obligated to terminate all engagement once a

participant expresses the desire to withdraw (Delost & Nadder, 2014; Huddy et al., 2015; Killawi et al., 2014). I used the first five minutes of the face-to-face interview time to remind the participants of their right to withdraw from the study before starting the official interview. No participants withdrew from this study.

Although monetary compensation can exert undue influence on participants, researchers have the option to offer incentives in manners that would not affect the reliability and validity of the participants' data (Ambuehl, Niederle, & Roth, 2015; Cajas & Pérez, 2017; Killawi et al., 2014). Offering incentives, such as lunch invitation or gifts of monetary value in the form of vouchers or gift cards to show an appreciation might encourage and promote participation (Bouter, 2015). To initiate and establish a good working relationship, as well as show my gratitude for the participants' willingness to support and participate in the study, I extended lunch invitations to the selected participants. Alternatively, I offered a Starbucks gift card to the participants whose busy schedule might conflict with the lunch proposal. No other form of compensation applied.

The Belmont report contains the core ethical principle aimed to protect human participating in biomedical and behavioral research (Belmont Report, 1979). Researchers conducting studies that involve human participants must abide by the Belmont Report ethical principles (Bracken-Roche et al., 2017; Judkins-Cohn et al., 2014; Yearby, 2016). The core ethical principle provisions include respect for persons, beneficence, and justice (Belmont Report, 1979). As outlined in the Belmont Report, I abided by the ethical

principles of respect for persons, beneficence, and justice when selecting participants, conducting the interviews, and reporting the findings.

Check, Wolf, Dame, and Beskow (2014) emphasized the need for researchers to store participants' interview data, archives, and other collected information relating to the study in a locked safe until after the retention expiration period. Although the length of retention and destruction period varies per research type, the general rule was to retain participants' data and records for a minimum of 5 years (Tavakoli & Jahanbakhsh, 2013). Researchers can employ a shredding technique as the efficient mechanism to destroy all participants' research data (Yin, 2015). I will store all research records in a locked safe in my home office for 5 years after the completion of the study. After the data retention period of 5 years, I will use a shredding system to destroy hard copy information relating to study. I will erase all soft copy of the data from my password protected recording system, backup hard drive, and cloud account to ensure that unauthorized persons can access no traces of the participants' information.

The 1979 Belmont Report provisions influenced universities' IRB policies relating to the appropriate use of human participants to conduct Biomedical and Behavioral research studies (Musoba, Jacob, & Robinson, 2014). Hence, the university's IRB mission is to encourage researchers to first, reduce unnecessary risks to human participants by utilizing research designs capable of leveraging existing data to conduct reliable studies (Fiscella, Tobin, Carroll, He, & Ogedegbe, 2015; Wild & Pratt, 2017). As outlined in most universities' IRB, scholars must obtain the IRB approval before

engaging prospective participants to participate in the research study (Fiske & Hauser, 2014; Delost & Nadder, 2014). I initiated participant engagement after receiving approval from the Walden University IRB. The Walden IRB approval number was 07-25-18-0597339.

Confidentiality in qualitative research refers to the measures researchers would take to protect the information participants disclosed based on trust and with an expectation that the researcher did not share the information in a manner that might violate the terms of the signed informed consent (Gomaa, 2016). I demonstrated confidentiality by using a password-protected digital resource, such as a recording device and backup hard drive, to collect and store participants' data. I backed up the recorded data on my password protected cloud account while storing the device used for the recording and the journal entry in a locked fireproof and waterproof security safe in my home office for the duration of the research study. During the data collection and analysis phases, as well as in presenting the findings, I used coding to protect the confidentiality of the participants. I coded the participants' names as P1, P2, P3, P4, and P5.

Data Collection Instruments

Researchers could use observation, structured, unstructured, or semistructured interviews, focus groups, Skype-enabled phone conferences, and organizational records for data collection instruments (Dastyar, Kazemnejad, Sereshgi, & Jabalameli, 2017; Ullah, Fayaz, & Iqbal, 2016). Some qualitative case study researchers prefer to use face-to-face, semistructured interviews and organizational documents as their data collection

instruments (Rimando et al., 2015; Suen, Huang, & Lee, 2014; Willgens et al., 2016; Yin, 2015). I used face-to-face and Skype-enabled, semistructured interviews and organizational documents as the data collection instruments for this study. I maintained a journal to record reflective notes during the interviews. I reviewed publicly available organizational documents and records relevant to the strategies that the participants used to reduce the bullwhip effect in their electronic component supply chain.

Some qualitative researchers use interview protocol to facilitate efficient and smooth interview experience (Malterud, Siersma, & Guassora, 2016; Morse, 2015; Porter, Graham, Bodily, & Sandberg, 2016). I used an interview protocol to conduct the interviews with my research participants (see Appendix B). With an interview protocol, researchers can control the type of information that the participants share (Houghton, Casey, & Smyth, 2017; Nair et al., 2017; Yin, 2015). Researchers use an interview protocol to promote consistency and enhance the effectiveness of the interviews (Lohle & Terrell, 2014; Peters & Halcomb, 2015; Yin, 2015). In addition, researchers use an interview protocol to enable the participants to focus their responses on the research topic to influence the collection of information-rich data (Houghton et al., 2017; Nair et al., 2017; Yin, 2015; Ziebland & Hunt, 2014). I used my interview protocol to ensure consistency during all the interviews and to focus the participants' responses on the central research question of this study (see Appendix B). I observed and document nonverbal communication from the participants within my research journal.

Qualitative researchers use open-ended interview questions to provide the participants the opportunity to describe their experiences about the central research question (Bowden & Galindo-Gonzalez, 2015; Knepp, 2014; Ziebland & Hunt, 2014). I used open-ended interview questions (see Appendix A) to enable participants to share their experience with the bullwhip effect and the strategy they used to reduce bullwhip effect amplification. Researchers use probing questions to gain clarification during the face-to-face interview with each participant while observing the participant's verbal and nonverbal expressions (Johnston, 2014; Lohle & Terrell, 2014; Ziebland & Hunt, 2014). I used probing questions as needed to gain clarifications from each participant.

Researchers use member checking to validate the accuracy of the researcher's interpretation of the participant's interview responses (Ang, Embi, & Yunus, 2016; Dikko, 2016; Harvey, 2015; Munn, Porritt, Lockwood, Aromataris, & Pearson, 2014; Robinson, 2014). I conducted member checking to afford the participants the opportunity to review and validate the accuracy of my interpretation of their interview responses. By using member checking, researchers provide participants the opportunity to provide feedback, correct interpretation errors, and affirm the trustworthiness of the researcher's interpretation (Harvey, 2015; Munn et al., 2014; Robinson, 2014). Upon the completion of the member checking, I integrated the participants' recommended changes into the final interpreted summary of the interview data. Additionally, I provided a corrected interpreted summary of interview data to the participants for a final validation of accuracy.

Data Collection Technique

The qualitative researcher uses various techniques to gather data to address the central research question (Dikko, 2016; Fusch & Ness, 2015; Yin, 2015). The data collection sources available to social and behavioral researchers are observation, face-to-face, structured, semistructured, or unstructured interviews, focus group, Skype, e-mails, surveys, and instruments (Dikko, 2016; Houghton et al., 2017; Yin, 2015). Some qualitative researchers use corporate archives as their secondary data collection source (Dikko, 2016; Houghton et al., 2017; Yin, 2015). I used semistructured, face-to-face or Skype interviews, and company documents as my data collection techniques.

I obtained approval to collect data from the Walden University IRB prior to engaging in any data collection efforts. I initiated the data collection process by sending an invitation to participant e-mail to the identified participants in Houston, Texas (see Appendix C). Researchers use e-mail as a communication tool to improve responsiveness, reduce cost, allow for faster follow-up, and enable valid documentation of the communication exchanges (Johnston, 2014; Lohle & Terrell, 2014). I obtained informed consent from each participant prior to conducting the interviews. I sent the participants an interview schedule with information about the interview setting and interview duration. I followed an interview protocol to ensure consistency among all the interviews (see Appendix B).

The advantage of using semistructured interviews as a data collection technique **is** that researchers can exert timely probing questions to clarify the participants' responses

while observing the participants verbal and nonverbal expressions (Houghton et al., 2017; Nair et al., 2017; Ziebland & Hunt, 2014). I used my interview questions (see Appendix A) to guide the interview. I also used probing questions to clarify participants' responses as needed. I monitored and document participants' nonverbal responses through the duration of the interview session. Another advantage of using semistructured interviews as a data collection technique is that researchers can collect instant information-rich data while conducting the interviews (Houghton et al., 2017; Nair et al., 2017; Yin, 2015). I used interview sessions to collect instant data for my research study. I used interview questions (see Appendix A) to keep the participants focused on the research topic and mitigated the risk of deviating from the central research question.

Researchers use semistructured interviews to conduct an in-depth exploration of the research problem (Farooq & de Villiers, 2017; Oates, 2015; Ziebland & Hunt, 2014). I used the probing questions to gain in-depth information about the participants' knowledge and experience relevant to the central research question. Researchers use interview techniques to reduce the cost associated with research study (Farooq & de Villiers, 2017; Oates, 2015; Yin, 2015). By using face-to-face or Skype interview techniques, I reduced travel and other research logistic costs. Scheduling conflicts make the semistructured interview techniques unattractive for some researchers (Krall, Wamboldt, & Lohse, 2015). Conducting leadership-level interviews could be intimidating for novice researchers because face-to-face interviews require unique skills and experience (Krall et al., 2015).

Researchers can use data retrieved from the organizational documents as a secondary data source (Check et al., 2014; Sherif, 2018; Yin, 2015). I reviewed organizational documents relevant to the research topic of the bullwhip effect. While a researcher can use the archives to attain information-rich data, reviewing and understanding the nature of historical data could be time consuming for some researchers (Check et al., 2014; Morse, 2015; Sherif, 2018; Widodo, 2014). I downloaded the data collected from company documents into the software to reduce the manual review time. Archived data might be subjective depending on the source, the operator, and the instrument used to gather the data (Check et al., 2014; Morse, 2015; Sherif, 2018; Widodo, 2014). I compared the documentation data with the interview data, as well as the data from my journal log to ensure reliability. Another disadvantage of relying on the organizational documents as a data collection source is that the leaders might not approve to release the company's documents driven by the corporate policy (Morse, 2015; Widodo, 2014; Zhang, Ye, & Lin, 2014). I leveraged the fact that my research topic affects most businesses within the IT supply chain industry to obtain corporate archives. Some supply chain leaders are publicly sharing their success in mitigating the bullwhip effect in their public websites under business sustainability documents. I reviewed publicly available company documents.

Qualitative case study researchers employ member checking to add rigor to their research outcomes (Houghton et al., 2015; Kobetz, Armstrong, & Valera, 2016; Sherif, 2018; Taylor & Thomas-Gregory, 2015). I used member checking to add rigor to my

study. I completed the face-to-face or Skype interviews with all my research participants and transcribed the content of the audio records before I engaged in member checking process. Researchers engage in member checking by inviting the participants to review and validate the accuracy of an interpreted summary of the interview transcript (Ang et al., 2016; Simpson & Quigley, 2016; Widodo, 2014). I created an interpreted summary of the interview transcripts, meet once again with the participants, and ask for their validation of the accuracy of the interpreted summary of their interview responses. I used the feedback from the participants to ensure accuracy and promote the credibility of the research outcome.

Researchers use a pilot, small-scale study to evaluate their research procedures, instruments, and methods that they intend to use within a more extensive research study (Gheondea-Eladi, 2014). The purpose of conducting a pilot study is to check the feasibility of the proposed plan before doing a large-scale research study or to make a predetermination of a specific data collection instrument (Dikko, 2016). I conducted a limited scope case study research in which I served as the data collection instrument. Therefore, conducting a preliminary study to test data collection instrument, method and procedure was not appropriate for this research study.

Data Organization Technique

The computer-assisted qualitative data software (CAQDAS) is one of the digital systems that researchers use to organize and track their research data (Ang et al., 2016; Houghton et al., 2015; Niedbalski & Izabela, 2016). Although MAXQDA and Atlas.ti

have comparable capabilities to NVivo, I used NVivo 12 for Windows as my chosen CAQDAS for my research data organization and tracking. I imported the participants' data from multiple sources and organize them using NVivo 12 software. As part of data organization technique, researchers use the NVivo 12 features to identify recurring words in the text to create word clouds and trees necessary for labeling and cataloging the identified themes and pattern (Ang et al., 2016; Emmel, 2015; Niedbalski & Izabela, 2016). I coded the participants recruited from (a) the factory as P1 and P2, (b) electronic component suppliers as P3 and P4, and (c) demand-planning organization as P5. Researchers use coding techniques and memos to safeguard the participants' privacy (Fiske & Hauser, 2014; Haahr et al., 2014; Niedbalski & Izabela, 2016). I used NVivo 12 coding feature and journal entry to keep track of and differentiate each participant's data. Researchers use NVivo 12 data retrieval scheme to gain easy access to various parts of the stored data details (Ang et al., 2016; Houghton et al., 2015; Niedbalski & Izabela, 2016). I used the NVivo 12 retrieval features to gain access to the stored participants' data as needed.

Researchers use various storage strategies to store participants' interview data, archive, journal log, and other collected information relevant to the study (Ang et al., 2016; Check et al., 2014; Robert, 2015; Yin, 2015). I used a password-protected hard drive to store my research participants' data. I created a backup of the interview transcripts and uploaded them to my password protected cloud account. Researchers are to retain their stored research data in a locked safe until after the retention expiration

period of 5 years (Check et al., 2014; Childs, McLeod, Lomas, & Cook, 2014; Tavakoli & Jahanbakhsh, 2013). I will store the hard drive device used for the interview recording, and my journal logs in a locked fireproof and waterproof security safe in my home office for the duration of the research study and after the retention expiration period of 5 years. After the data retention period of 5 years, I will use a shredding machine to destroy the hard copies of my research data. I will erase the electronic copies of the data from my password protected recording system, backup hard drive, and my cloud account.

Data Analysis

Data analysis is the critical element of social science research (Wolff-Michael, 2015). Data analysis is the evolution of events that researchers must undertake to transition from data collection phase to data organization, understanding, and explanation of the phenomenon under study (Theron, 2015). Qualitative research data analysis is a dynamic process that evolves with the emergence of data. Qualitative researchers use triangulation of data from multiple sources to facilitate the investigation of a phenomenon, as well as address the central research questions (Colorafi & Evans, 2016; Stewart & Gapp, 2017). Researchers use methodological triangulation method to compare data collected from multiple sources, such as data from research participants' interviews, organizational documents, and journal notes (Colorafi & Evans, 2016; Stewart & Gapp, 2017; Yin, 2015). I collected my research data from multiple sources through the following methods: (a) face-to-face interviews, (b) Skype interviews, (c)

organizational documents, and (d) journal notes. I used methodological triangulation method to triangulate my research data collected from multiple sources.

During data analysis phase, researchers initiate the transcription of interview transcripts, scrutinize the transcribed data, identify themes, and patterns, and determine ways the observed themes and patterns could address the central research question of the study (Selçuk, Palanci, Kandemir, & Dündar, 2014). Data analysis technique **is** an integral aspect of a qualitative research study that researchers use to achieve an optimal interpretation of interview transcripts; add rigor, quality, and dependability to the research outcome (Huang et al. 2014; Stuckey, 2015). To ensure rigor, qualitative researchers follow logical steps when analyzing their research data. The data analysis begins with the interpretation of interview transcripts, coding, identifying themes, patterns, groups, and subgroup sequences. I used the data analysis techniques to analyze the transcribed participants data, organizational documents, and data from journal note to facilitate the understanding of the strategies leaders used to reduce the bullwhip effect in the electronic component supply chain. Qualitative case study researchers utilize five-step phases to conduct effective research data analysis. The five-step phases include (a) data collection, (b) data stratification, (c) data reassemble, (d) data interpretation, and (e) conclusion (Cho & Lee, 2014; Colorafi & Evans, 2016; Houghton et al., 2015; Yin, 2015).

Data Collection Phase

Theron (2015) recommend for qualitative researchers to initiate data analysis process immediately following the collection of the first piece of research data. Researchers' review of the initial data helps to note apparent themes needed to set the tone for other emerging datasets (Theron, 2015). Through the analysis of the first set of collected data, researchers could leverage the identified themes and patterns to analyze other datasets that would arise from additional participants interviews (Cho & Lee, 2014). Although data transcription is a cumbersome process, researchers must transcribe verbatim the audio-recorded interview data to convert the participants' spoken words into written words (Colorafi & Evans, 2016; Theron, 2015). Researchers would use the transcribed data to facilitate data analysis (Cope, Wood, Francis, & Chestnutt, 2015). Using my interview protocol (see Appendix B), I conducted face-to-face interviews with my research participants. I used my research journal to take notes during the interviews. The notes were relevant to the participants' verbal and nonverbal reactions. I also documented the participants' demeanor, their response pattern, and response completeness. I used probing questions to gain clarifications based on the participants' responses. I reviewed publicly available company documents. I started my data analysis upon the completion of the first participant interview. During the analysis, I identify apparent themes to facilitate trend for the data that would arise from the remaining scheduled participants' interviews. I transcribed the audio recording of the first participant's interview and triangulated the transcribed data with journal notes from the

interview, and the participant's organizational archives. I used the triangulation of various data sources to identify themes, and patterns relevant to the strategies leaders used to reduce the bullwhip effect in their electronic component supply chain. I used the designated themes and patterns as the building block for the emerging data from the other scheduled participants' interviews, organizational documents, and data from my journal notes.

Data Stratification Phase

Data stratification is the core of qualitative data analysis. Content analysis is one of the data stratification methods that researchers employ to analyze research data (Gökmen et al., 2017; Selçuk et al., 2014). Researchers use content analysis to identify keywords and phrases from raw data that reveals the underlying meaning of the transcribed interview data relevant to the central research question. Researchers use varying Computer-assisted Qualitative Data Analysis Software (CAQDAS) coding technique to identify emerging themes and patterns within the datasets efficiently. Researchers use CAQDAS labeling capabilities to code, label, and extract keywords from raw data (Elo et al., 2014; Houghton et al., 2015). The assertion was that creating a starting code list derived from the central research question of the study would make the coding process manageable (Elo et al., 2014; Houghton et al., 2015). I used NVivo 12 data stratification strategy to label, identify keywords, phrases, themes, and patterns that might facilitate the understanding of the meaning of the participants' information. I used coding technique to differentiate each participant's content. I assigned P1 and P2 to the

factory participants' data, P3 and P4 to component suppliers' data, and P5 to the demand-planning organizational data. I segregated the stratified data into groups, subgroups, themes, and patterns.

Data Reassemble Phase

Qualitative researchers use data reassemble phase to draw together like coded words and phrases based on their patterns of occurrences (Cho & Lee, 2014; Colorafi & Evans, 2016; Ngulube, 2015; Yin, 2015). The coded words, themes, and phrases need to be action-oriented to add value to the study. The organized themes stem from the coded words drawn together to develop relationships. The relationship facilitates data interpretation relevant to the central research question of the research study (Van & Struwig, 2017). Upon the completion of data stratification using NVivo 12 functionality, I reassembled the coded words, phrases, themes, and patterns to develop relationships among the groups and subgroups of the stratified data. I linked the coded words, themes, patterns with their ties to the interview questions (see Appendix A) relevant to the central research question. I used the integrated themes, patterns and their relationships to facilitate the interpretation of the participants' information that would address the research question.

Data Interpretation Phase

Qualitative researchers can use any combination of data collection, stratification, and reassemble techniques to aid in the interpretation of the research outcome (Kulkarni, 2016). Researchers wear the participants' hats when interpreting qualitative data to

envision the phenomenon from the participant perspective (Theron, 2015). Qualitative researchers use data interpretation phase to be true to the participants and draw meaning from their research data based on the participants' perception of the phenomenon (Theron, 2015). Data interpretation process involves comparing and contrasting themes, patterns, and clusters. I initiated data interpretation after reassembling the words, phrases, themes, and patterns. I compared the themes and patterns developed from the interview, organizational documents, and journal notes. I identified and linked the relationship between the various themes, groups, and subgroups to facilitate descriptive interpretation of the strategies leaders used to reduce the bullwhip effect in their electronic component supply chains.

Data Conclusion Phase

Qualitative researchers use the combination of data collection, stratification, reassembling, and interpretation to draw meanings from the participants' information relevant to the central research question of the research study (Nielsen & Hjørland, 2014; Sarros, Luca, Densten, & Santora, 2014). Researchers can also use the data interpretation phase to identify strategies and gaps in the research to enable conclusion drawing (Yin, 2015). To conclude my research study outcome, I connected the relationship linkage of the detailed interpretation of the combined themes, patterns, groups, and subgroups of coded words from the participants' interviews, organizational documents, and journal notes. I linked the established relationships to the central research question relating to the strategies the leaders used to reduce the bullwhip effect. I drew meaning from the

participants' information, report the findings of the study, and identify gaps in the research study for a further research study.

Methodological Triangulation

Methodological triangulation is a method that qualitative researchers use to compare data collected multiple sources (Yin, 2015). Researchers use triangulation of various approaches to investigate the phenomenon and address their central research questions (Colorafi & Evans, 2016; Stewart & Gapp, 2017). Concurrently, researchers use methodological triangulation to ensure rigor, credibility and enhance confidence in their research outcome (Cho & Lee, 2014; Colorafi & Evans, 2016). Qualitative researchers employ methodological triangulation to combine, compare, and contrast research data collected from a variety of sources, such as face-to-face, skype interviews, organizational documents, observation, journal log, and notes (Fusch & Ness, 2015). Researchers use methodological triangulation to minimize research bias in the data, reduce misinterpretation during member checking, enhance rigor, and credibility (Cho & Lee, 2014; Fusch & Ness, 2015; Ngulube, 2015). I used data from the face-to-face, Skype interviews, publicly available organizational documents, journal entries, and other documents relevant to the research topic to engage in methodological triangulation.

Computer-Assisted Qualitative Data Analysis Software (CAQDAS)

Effective research data management is the essential factor for a successful qualitative research study (Cope, 2014). CAQDAS is a digital technology software developed to facilitate efficient data management and analysis to reduce human error

(Houghton et al., 2015). NVivo 12 is one of the CAQDAS that qualitative researchers could use to code collected data, identify themes, patterns, phrases, and clusters (Ang et al., 2016; Niedbalski & Izabela, 2016). Case study researchers utilize NVivo to explore their research data vertically and horizontally, organize code and classify trend, identify themes and comprehend the meaning of the participants' information and perspectives (Houghton et al., 2015). Researchers' use NVivo's data retrieval access feature to gain access to various parts of the data details and create word clouds necessary for modifying assigned codes (Emmel, 2015; Niedbalski & Izabela, 2016). I used NVivo 12 as my primary CAQDAS digital technology to conduct my research analysis. With NVivo 12, I managed my research data and ideas efficiently. Staying current on research topics is an essential component of researchers' responsibility (Yin, 2015). Researchers could sign up for a search alerts system to receive the present and future publications relevant to their research topics (Salmona & Kaczynski, 2016)). Researchers use the search alert systems to receive automatic alerts through e-mail whenever new topics pertinent to their researcher topics are available (Wray, 2016). I signed up for the Walden Library and Google Scholar search alert systems to receive publications that are relevant to my research topic.

Key Themes

Following logical research data analysis and coding the data around themes are the primary qualitative research characteristics (Joseph, 2014). Researchers use NVivo to store, manage, and query collected data. The node structure within NVivo facilitates

efficient data storage. Researchers could employ the node structure capability to (a) code stored data; (b) create memos; (c) sort and organize; and (d) classify data into word frequencies, themes, and phrases (Houghton et al., 2015). Researchers could use NVivo's word cloud and tree capabilities to isolate and label frequently appearing words and patterns in their datasets (Niedbalski & Ślęzak, 2016). Qualitative researchers are encouraged to initiate data analysis process following the collection of the first set of interview data to identify prominent themes and partners to build upon while monitoring emerging themes with the collection of more data (Cho & Lee, 2014; Theron, 2015). Houghton et al. (2015) recommended using broad coding to create interim theme start lists linked to the central research question. Using my central research question, I established a provisional broad coded list of prominent themes. The provisional list consisted of the strategies supply chain leaders used to reduce the bullwhip effect in their electronic component supply chain. Therefore, the initial themes linked to my central research question include (a) component shortage, (b) inventory buffer, (c) unforecasted demand upside, (d) network member collaboration, and (e) bill of material management. I built emerging word frequencies, themes, and patterns around the established prominent themes.

Reliability and Validity

Researchers use the qualitative method to explore complex social science phenomenon requiring participants with diverse perspectives to address the central research question of the phenomenon under study (Birchall, 2014; Danielsson &

Rosberg, 2015; Yin, 2017). Qualitative researchers use a case study design to explore participants' experiences in great depth within the natural setting where the event occurred (Yin, 2017). I used a qualitative case study to explore the strategies supply chain leaders used to reduce bullwhip effect in their electronic component supply chain. In a qualitative case study, reliability refers to dependability. Validity relates to credibility, confirmability, and transferability. I addressed how I established dependability, credibility, confirmability, and transferability of my qualitative case study research in the following content.

Dependability

The reliability of a qualitative research study refers to a researcher's ability to address the dependability of the research outcome (Dikko, 2016). Establishing research dependability is imperative because dependability assures repeatability of a study in a comparable situation (Cope, 2014; Dikko, 2016). Attaining research dependability involves full documentation of steps used for data collection, analysis, interpretation, and reporting of the study outcome (Morse, 2015; Syed & Nelson, 2015). Qualitative researchers use structured interview questions and protocol to gather information-rich data from multiple participants with in-depth knowledge of the situation under study (Yin, 2017). Case study researchers use recorded semistructured interviews, direct participants observations, reflective journal, and organizational documents to collect data (George et al., 2015; Kantola & Saari, 2014). Methodological triangulation is strategy researchers use to integrate and analyze data collected from multiple sources to expand

the depth of understanding of the participants' information-rich data (Ang et al., 2016; Morse, 2015; Turner, Cardinal, & Burton, 2016; Stewart & Gapp, 2017). Qualitative researchers transcribe the data, code, and identify themes and patterns, then use member checking to ensure the quality and accuracy of the transcribed information (Ang et al., 2016). By using member checking, researchers afford the interview participants the opportunity to validate and affirm the trustworthiness of the researchers' interpretation of the interview data (Ang et al., 2016; Munn et al., 2014).

To enhance the dependability of my research outcome, I used interviewed questions (see Appendix A) and an interview protocol (see Appendix B) in semistructured interviews to collect audio-recorded data. I used probing questions to gain clarifications from the participants. I used the reflective journal to meticulously document my observation of the participant's nonverbal behavior and step-by-step data collection approach, and other considerations noted during the interviews. I collected archives from each participant relevant to the phenomenon under study. I used methodological triangulation to expand the depth of my understanding of the data from the participant's perspectives. I used member checking to validate the trustworthiness of my interpretation of the participants' data. By following the steps outlined above, I achieved data saturation that influenced research study dependability.

Credibility

Case study researchers explore social science phenomenon through participants with in-depth knowledge of the situation then use interpretive approach to report findings

(Leung, 2015). Case study research stems from human involvement that adds bias (Leung, 2015). To reduce bias, case study researchers need to establish credibility to ensure trustworthiness of the research study outcome (Connelly, 2016; Hays, Wood, Dahl, & Kirk-Jenkins, 2016). The credibility refers to the level of rigor that a qualitative researcher employs to ensure confidence in the data collection process, interpretation, and the overall quality of the study (Prion & Adamson, 2014). To ensure credibility, researchers need to establish transparency through meticulous documentation of the rigorous techniques used to conduct the research study (Cope, 2014).

Case study researchers use methods, such as purposeful sampling, participant engagement, maintaining a reflective journal of the observation, and member checking, to establish credibility (Amankwaa, 2016; Connelly, 2016). Qualitative researchers use software-enabled tool capabilities to analyze the triangulated research data to enhance credibility (Ang et al., 2016). Case study researchers can use a well-documented data collection method, interpretation, triangulation, and member checking to ensure credibility (English, 2015; Rodham, Fox, & Doran, 2015). To ensure credibility for my research study, I used purposeful sampling to select my research participants and maintain a relationship with the participants. I used different methods to collect my research data, use methodological triangulation, and a software-enabled tool to ensure the credibility of the data. I performed data interpretation and use member checking to validate the accuracy of the interpreted data.

Confirmability

Confirmability is the measure case study researchers use to ensure accurate representation of the research data from the participant's perspectives (Hays et al., 2016). Qualitative researchers use accurate documentation of the processes used for the study as the evidence to link data collection and analysis process steps to the central research question of the phenomenon under study (Pourghane, Nikfam, & Ahmadi, 2017). To ensure accurate representation of participant data, researchers use epoché approach to set aside bias driven by prior knowledge of the subject matter (Sorsa et al., 2015). Researchers use bracketing to detach their personal views, beliefs, and ethics during data collection (Sarma, 2015; Toews et al., 2016). Case study researchers employ multiple sources of evidence to reduce bias and promote confirmability (Leung, 2015; Noble & Smith, 2015; Tong & Dew, 2016; Yin, 2017).

Multiple sources of data are the optimum approach researchers use to facilitate methodological triangulation (Zamoscik, Godbold, & Freeman, 2017). Applebaum (2014) noted the value of using a reflective journal to reduce bias. Researchers use a triangulation technique to address the construct validity concerns of a case study research (Pourghane et al., 2017). Case study researchers use an interview protocol and open-ended questions to facilitate interview consistency and reduce pre-data collection bias (Alby & Fatigante, 2014; Haahr et al., 2014; Peters & Halcomb, 2015). Qualitative researchers need to analyze, interpret and report all data collected from the participants, then use member checking to confirm transparency and accurate representation of the

participant's data (Naci et al., 2014; Toews et al., 2017; Unkovic et al., 2016). I used reflective journal throughout the data collection and analysis processes to keep a record of the interview activities and to minimize bias. I asked each leader the same open-ended questions in the same order while using bracketing technique to mitigate bias. I maintained well-documented evidence that would track my data collection and interpretation back to the central research question. I used member checking to affirm the confirmability of the research outcome.

Transferability

Transferability is one of the criteria researchers use to demonstrate rigor in their research study (Connelly, 2016; Cope, 2014). Hence, transferability refers to nature under which the outcome of the research study is useful to other researchers or readers (Connelly, 2016). Meanwhile, researchers use transferability as a measure to ensure adequate documentation of the research assumptions, an interview protocol, and data collection sources (Cope, 2014). Cope (2014) asserted that some researchers use a reflective journal to document the steps used to conduct the research studies. Qualitative case study researchers use data saturation to facilitate transferability of their research outcomes (Fusch & Ness, 2015). Researchers attempt to establish transferability by conducting a case study research with a high degree of dependability, credibility, and confirmability (Laitinen, Kaunonen, & Åstedt-Kurki, 2014). Nevertheless, the transferability of the research outcome is solely at the discretion of future researchers or

readers to determine if the research outcome is transferable to another setting or other case studies (Bickerstaff, Devine-Wright, & Butler, 2015; Elo et al., 2014).

Data Saturation

Researchers use data saturation as the technique to ensure that data collected is sufficient to address the central research question of the study (Fusch & Ness, 2015; Hancock et al., 2016; Widodo, 2014). Case study researchers use data saturation to establish rigor, enhance transparency, credibility, and dependability of the research outcome (Fusch & Ness, 2015; Hancock et al., 2016; Widodo, 2014). To reach data saturation, researchers must demonstrate that they have gathered enough information-rich data from multiple sources to facilitate replication of the study (Boddy, 2016; Fusch & Ness, 2015; Morse, 2015; Widodo, 2014). Researchers should collect data until no new themes and patterns emerge, additional coding of data is no longer possible, and further data collection no longer resulted in new information (Boddy, 2016; Fusch & Ness, 2015; Morse, 2015; Roy et al., 2015; Widodo, 2014). The use of an interview protocol to ensure consistency among all the interviews, member checking, and methodological triangulation of multiple sources of data are how researchers attain data saturation (Fusch & Ness, 2015; Yin, 2015). I used an interview protocol to ensure consistency among all the interviews (see Appendix B), engage the participants in member checking, and use methodological triangulation of multiple sources of data to reach data saturation. I continued data collection until no new patterns or themes emerged. I reached data

saturation after the fifth interview because the data collected became repetitive, resulting in no new information.

Transition and Summary

In Section 2, I discussed the critical activities qualitative researchers must undertake to demonstrate their ability to address social science research challenges. The discussion includes the process that qualitative researchers use to select and acquire their research participants. I identified my research participants' eligibility criteria and the strategies I used to gain access to the participants. I also detailed the procedures I followed to establish a working relationship with my research participants. The discourse includes the plan to align participants with the central research question of the study. I provided a detailed analysis of the research method and design considerations. I covered mixed, quantitative, and qualitative research methods. I evaluated the case study research designs, and the means to reach data saturation.

In Section 3, I present the findings of the study, recommendations, and propose further research study. The research finding presentation includes a detailed analysis of how I used participants' responses, archives, and journal logs to develop themes and patterns. I discuss how I used the themes and patterns to address the central research question of my study. I offer practical business and social change improvement opportunities for IT supply chain leaders. The discourse includes recommendations for further research study as well as a discussion on how other researchers can apply the

outcome of this study to a different geographical location. I conclude Section 3 with a summary of the research.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this multiple case study was to explore strategies some supply chain leaders use to reduce the bullwhip effect on their electronic component supply chain. To explore the study topic, I interviewed five IT supply chain leaders who successfully implemented sustainable strategies that reduced the bullwhip effect. I obtained and reviewed supporting documents, including manufacturing cycle flowcharts, manufacturing capacity flexibility plans, supply flexibility plans, operational process flowcharts, product technology plans, and flexible manufacturing plans, inventory buffer stock plans, forecast performance waterfall processes, and the beer game simulation video link.

I linked the findings to Forrester's (1961) original bullwhip effect theory. I identified four themes from participants' responses to the interview questions. The four themes were collaboration strategy, communication strategy, component shortage reduction strategy, and resource management strategy. The findings of this study indicated that the supply chain leaders achieved success in reducing the bullwhip effect by using (a) a collaboration strategy to achieve optimum end-to-end operational efficiencies, (b) an effective communication strategy to remove the gap in forecast and demand information flow, (c) a component shortage reduction strategy to manage demand variability, and (d) a resource management strategy to integrate operational network systems and improve human resources engagement.

Presentation of the Findings

The purpose of this qualitative multiple case study was to answer the overarching research question, What strategies do some IT supply chain leaders use to reduce the bullwhip effect on their electronic component supply chain? I conducted semistructured interviews with five IT supply chain leaders who successfully implemented strategies to reduce bullwhip. All five participants approved the audio recording of the conversations and agreed to participate in member checking to validate the transcription of their interview data. I coded participants' names as P1, P2, P3, P4, and P5 to ensure their privacy and confidentiality.

I transcribed the narrative data upon the completion of each interview and prepared an executive summary of my interpreted data, which I used to conduct member checking with each participant. I used member checking to validate and confirm the accuracy of my interpretation of the participants' recorded responses. I leveraged the member checking process to clarify the additional questions that I noted while transcribing each participant's information. Additionally, I used the member checking process to ensure that I gathered all the information that I needed from each participant to answer my research question.

After completing the member check process, I uploaded my research data for the first participant into the NVivo 12 software program. Using NVivo, I performed data stratification to identify and extract themes and patterns from the participant responses and organizational documents. I repeated the interview process with the next research

participant until uploading all data into NVivo 12. I reassembled the coded data and continued to code out other themes, patterns, and clusters that emerged from new interview data. I noted that new themes and patterns were no longer emerging after the third participant interview. I conducted the fourth interview to see if new themes would emerge. The data from the fourth interview did not result in new themes or patterns; neither did the data from the fifth interview. I used the fifth interview to confirm that I had reached data saturation for my research.

After participants validated the accuracy of my interpreted responses, I compared the participants' responses to their organizational records. Furthermore, I triangulated the interview data with the organizational documents, which indicated redundancies that confirmed attainment of data saturation. After attaining data saturation, I performed data stratification to identify and extract themes that emerged from the triangulated data. Four themes emerged as the key strategies that the five participants used to reduce the bullwhip effect on their electronic component supply chain. The four key themes that emerged were (a) collaboration strategy, (b) communication strategy, (c) component shortage reduction strategy, and (d) resource management strategy. Table 1 displays the emergent themes and the percentage of use by participants' companies.

Table 1

Strategies Used to Reduce the Bullwhip Effect in Electronic Component Supply Chains

Strategy	Percentage of use by companies
Collaboration strategy	100%
Communication strategy	100%
Component shortage reduction strategy	100%
Resource management strategy	100%

Theme 1: Collaboration Strategy

The supply chain leaders who participated in this study used a collaboration strategy through negotiated agreements and information sharing policies to establish trust within their supply chain network. With the established trust, participants worked collaboratively to gain insights into the long-term forecast. The five participants used demand forecast information to determine how best to apply controlled operational activity flow from wafer start to end customer shipments. I used the participants' manufacturing cycle process flow charts to confirm the effectiveness of the participants' use of collaboration strategy to reduce the bullwhip effect. The participants used controlled and shared operational activities and accountability to achieve success in bullwhip effect reduction. This finding confirms the findings of Wang and Ran (2018) in that supply chain leaders used a collaboration strategy to sustain critical operational imperatives used to reduce the bullwhip effect in the electronic component supply chain.

Pataraarechachai and Imsuwan (2017) also noted that leaders use collaboration as a critical strategy to mitigate bullwhip effect drivers.

All five participants noted the need to gain and use intelligent market data to compare inventories during distribution to meet the anticipated customer demand shifts. My review of participant responses and organizational documents allowed me to gain insight about the various collaboration approaches used by the participants to reduce the bullwhip effect. The participants employed the end-to-end approach and operational process alignment as a fundamental part of a collaboration strategy. Table 2 displays the subthemes of the collaboration strategy used by leaders to achieve optimum end-to-end operational efficiencies while reducing the bullwhip effect.

Table 2

Subthemes of Collaboration Strategy

Subtheme	Percentage of use by companies
End-to-end approach	100%
Operational process alignment	100%

End-to-end approach. The five participants expressed the importance of using end-to-end collaboration tactics to reduce the bullwhip effect. I used manufacturing cycle process flow charts obtained from each participant's company to support the end-to-end approach as a valid collaboration strategy. P1 used historical collaboration data to identify key bullwhip effect triggers at each network process step, then work

collaboratively to implement appropriate actions to reduce the amplification of the bullwhip effect triggers. P2 and P5 increased collaboration frequencies with manufacturers and end-customers. P2 and P5 used increased collaboration frequencies to vet sudden demand change input from end customer compared to the end customer's short-term forecast. As part of the collaboration frequency, the two participants would feed the vetted demand data into the systems to run through the network operational process flow.

P3 adopted end-to-end continuous process improvement as a key collaboration strategy. P3 stated, "One of the things we use to differentiate ourselves is our end-to-end supply chain strategies because initially, we did not have the technology to differentiate ourselves. Now we do have technology to differentiate ourselves." P3 confirmed the success in the use of continuous process improvement to reduce the bullwhip effect. P4 used a collaboration strategy to gain direct access to end customers' demand requirements. With the confirmed end customer requirement, P4 would determine the appropriate component wafer and package technologies to use to address a customer need. P4 used the wafer and package technology information to devise a plan to initiate controlled wafer start using baseline technology to ensure multiple markets demand support. Additionally, P4 worked collaboratively with the channel partners to extract and evaluate real-time point of sale component sell-out data to confirm shelved inventory turnover rate. P4 stated,

> We work collaboratively with our customers to gain better picture of their demand. If the demand is for the commodities using the same package for multiple distributors, we do go and look at the channel partner's point of sell (POS) data to see if they're buffering inventory in anticipation of demand surge, as well as confirm how fast inventories are leaving their shelves. If the partners' point-of-sell data show that they do not have a shortage, we will adjust what we ship them to be able to take care of other customers.

In so doing, P4 reduced partners' urge to engage in shortage gaming for inventory buffering in anticipation of demand surge thereby reducing the bullwhip effect. Raza and Kilbourn (2017) noted that an effective end-to-end network partner collaboration strategy could lead to improved operational performance. Schoemaker and Tetlock (2017) noted the importance of using sustained collaboration strategy to remove operational waste in the form of bullwhip effect and gain competitive advantage.

Operational process alignment. All five participants emphasized the need to place great value in aligning key network partners' operational processes. P1, P2, and P5 discussed the use of infrastructure systems to acquire and evaluate channel partners' point of sale data and feed real-time aggregated sales and order data into the integrated network systems. P2 stated,

> Oftentimes, supply chain partners would communicate big demand changes from week-to-week or month-to-month, which are not sustainable over a longer period. What we found is that some of our manufacturing partners were responding to

> signals from the end customers about demand changes that were maybe system errors or maybe things that will smooth out over time.

P3 noted that the internal sales organizations play a critical role in the effort to reduce bullwhip effect because of the sales partner direct interface with the end customers. P4 explained the value of using infrastructure to gain immediate access to channel partners' point of sale data. P4 use the system generated channel data to determine the regions that are at component shortages risks or possess excess inventory. P4 used the assessment outcome to facilitate channel inventory adjustment decision. Hence, P4's plan inventory replenishment strategy for channel partners based on regional need helped to reduce the risk of triggering the bullwhip effect. This finding confirms the research of Cannella et al. (2018), who noted that leaders should use infrastructure systems to achieve real-time information sharing pertinent to demand requirements, component availability, and factory capacity to reduce lead-time concerns and achieve on-time delivery of customer orders through the reduction of bullwhip effect.

Correlation to the conceptual framework. The participants' use of network assets as a collaboration strategy to reduce bullwhip effect triggers on their electronic component supply chain is consistent with the bullwhip effect theory originated by Forrester's (1961). Bullwhip effect theorists noted that organizational resources are the source of sustained business performance, as well as operational disruptions (Pfeffer & Salancik, 1978). The participants successfully used a collaboration strategy to improve

internal and external resources, which reduced the bullwhip effect and influenced optimum end-to-end operational performance.

Theme 2: Communication Strategy

The data analysis indicated a second theme, which was the participant's use of communication strategy to reduce the bullwhip effect driven by a gap in demand and capacity information sharing. I used the participants' manufacturing capacity flexibility documents to confirm the use of communication strategy to reduce bullwhip effect. Tieman (2017) found that efficient supply chain management requires steady communication flow between network partners. Cannella et al. (2018) reduced the gap in information sharing by proactively managing input and output demand information.

All five participants explained the benefit of using an effective communication strategy to remove redundancies, gain smooth operation activities, and mitigate the bullwhip effect triggers. The five participants noted effective use of communication strategy to vet incoming demand data and timely feed the outcome of the vetted data to the network partners communicate systems. Kache and Seuring (2017) found that leaders employ digital communication systems to improve the speed of the demand input and output information transfer. I noted, through the analysis of the participants' responses and the documents, that each participant used a unique communication strategy to reduce the bullwhip effect.

The participants discussed the unique communication tools employed, such as beer game simulation, inventory level monitoring, and forecast management. Table 3

displays the subthemes of the communication strategy used by leaders to remove the gap in forecast and demand information flow thereby reducing bullwhip effect achieve optimum end-to-end operational efficiencies while reducing the bullwhip effect.

Table 3

Subthemes of Communication Strategy

Subthemes	Participant	Percentage of use by companies
Beer game simulation	P1	20%
Inventory level mentoring system	P2, P3, P4, P5	80%
Forecast management	P1, P2, P3, P4, P5	100%

Beer game simulation. P1 discussed the use of beer game simulation within communication strategy. P1 stated,

> Part of our supply chain culture is to use the beer game strategy to provide our employees the visibility to the adverse effect of bullwhip in supply chain. Hence, all demand forecast planning requirement to take the beer game simulation class.

I used the participant's beer game simulation video to support the beer game simulation class as a communication strategy to reduce the bullwhip effect. The beer game simulation program is an integral part of P1's corporate system-level thinking. As such, P1's corporate culture included the use of the beer game as a communication strategy to

reveal adverse implication of the bullwhip effect to the human network resource. Hence, P1 required all demand forecast planning human resources to take the beer game simulation class. The supply chain human resources used the beer game simulation strategy to gain firsthand experience on how the bullwhip effect works and acquire skills to monitor and manage the bullwhip effect behavior proactively. Upon the completion of the beer game training, the P1 human resources gain sustained skills to effectively communicate bullwhip effect signs and implement risk mitigation plan aimed to reduce bullwhip effect triggers.

P1 explained that since every member of the organization takes the same beer game class, the course content became basic communication language used throughout the supply chain environment. P1 stated, “The nice thing about the beer game class is that everybody learns to use a common language. Using a common language makes it easier to conduct a conversation about a complex subject in a few words within a broad network.” The fact that network partners can use few keywords to explain the implication of a complex bullwhip effect phenomenon makes the beer game relatively a powerful communication tool to manage, minimize total supply chain cost, and reduce adverse bullwhip effect consequences. This finding confirms the research of Bandaly et al. (2016), who noted that supply chain leaders use simulation strategy for early identification and mitigation of bullwhip effect triggers. This finding confirms the findings of Shukla and Naim (2017) in that supply chain leaders use an educational approach to foster regular cross-competence training and form personal relationships,

which is vital to network partners' satisfaction. Satisfied business partners gain the motivation to participate in the quest to reduce bullwhip effect triggers.

Inventory level monitoring. Four participants, P2, P3, P4, and P5, mentioned inventory level monitoring as a communication strategy. I used the participants' supply flexibility plan documents to support inventory level monitoring as a part of communication strategy. P2 stated, "We would extend our lead times, forecasting window, and establish and communicate our Annual Operating Plan to the customers. In return, we ask the customers to provide input into the plan 12-18 months in advance." The four participants discussed inventory level monitoring as an important communication strategy used to determine the strength of the channel demand signal. Inventory depletion at the channels confirms strong market demand signal, which indicates the need to trigger new wafers start at the manufacturing factory. Otherwise, inventory level monitoring showing weak signal informs shortage gaming used by some channel partners to secure buffer material in anticipation of demand surge. This finding confirms the research of Kumar (2017), who advocated for supply chain leaders to use inventory level monitoring as a communication strategy to rationalize the demand signals transmitted to and from network partners. The findings confirms the findings of May et al. (2017) in that an effective supply chain leaders use a communication strategy with appropriate management of inventory levels at each network process step to ensure support for unanticipated demand surge and to reduce the bullwhip effect.

Forecast management system. All five participants discussed the use of forecast management systems to communicate available component supply for short-term demand, unanticipated demand surge, and long-term forecast. I used the participants' strategic supply-flexibility-plan documents to support forecast management system as an integral part of communication strategy used to reduce bullwhip effect. The five participants used integrated forecast management system for evaluating actual demand versus consumption and use the system to communicate buffer stock levels and replenishment plan to network partners. The participants established a component ordering policy with major customers to manage buffer inventories and demand variability.

The strategic supply-flexibility-plan documents indicated how each participant positioned flexible inventories at separate geographically diverse locations driven by customers' consumption rate. The data collected from the five participants and the supporting documents indicated forecast management system to be a critical communication strategy to reduce the bullwhip effect. This finding confirms the findings of Ahmad and Zabri (2018), who noted the benefit of using a forecast management system to account for inventory levels and dynamic component ordering policy to manage demand variability. This finding confirms the research of Choudhury (2018) in that forecast management system is a powerful communication tool to share forecast information to reduce demand variability implications while sustaining partner relationship, business growth, and competitive advantage.

P2 discussed how data scrutinization is an integral part of their company culture. Hence, the operation employs forecast data scrutinization at a very low level to ensure accurate partner demand. P2 stated,

> The culture within our company is to scrutinize data at a very low level. We literally have a forecasting process monthly, where we are forecast out what kind of forecast we have, the revenue projection, and the sales projection for the next 6 months. Twice a year, we would generate the annual operating plan forecast, which is 12 or 18 months forecast.

P2 explained that the generation of annual operating plan forecast occurs twice a year. Then, employ a series of forecasting data scrutinization with end customers to validate actual demand. The communication of the vetted demand data goes through the forecast management system to network partners to smooth buffer inventory levels and reduce bullwhip effect. This finding confirms the research of Lucie (2017) in that supply chain leaders use input and output vetting technique to reduce demand variability. This finding confirms Schoemaker and Tetlock (2017) in that integrated forecast management system facilitates faster communication with network partners, reduce the gap in customer demand information flow, and dampen bullwhip effect.

P3 held monthly forecasting review as value creation within the communication strategy used by network partners to evaluate short-term demand, projected revenue, and sales projections. P3 implemented a monthly forecast monitor and communication process at the transition point between the business award, product ramp, and mass

production phases. Through the forecast monitor and communication process, P3 enabled early engagement with their internal sales partners and identified the three months window where the sales forecast is stable. The validated data goes through the network communication system to trigger an appropriate wafer start at the factories. P3 clarified that the core transition point between the three months handoff to production is where the demand forecast can fail because of the discrepancy between the sales partners and other network partners. This finding confirms research of Govind et al. (2017) in that the use of appropriate metrics to monitor forecast data positively affects communication flow and reduces the bullwhip effect. This finding confirms the research of Tieman (2017) in that early engagement and effective communication strategy improves forecast management process and timely communication with network partners.

P1, P4, and P5 discussed the value of using close and frequent communication strategy to compare network partners forecast to actual demand before feeding the forecast data into the network forecast management system. P5 stated, “We ask our customers and use our company bargaining power to allocate the parts with the vendors using our history of transactions and distribute accordingly to each operational site.” The use of direct customer engagement and timely communication of vetted demand date plays a vital role to improve the forecasting process and reduce bullwhip effect. This finding confirms Choudhury (2018) in that supply chain leaders use forecast management as a powerful communication strategy to reduce customer demand variability, sustaining partner relationship, ensure business growth while reducing bullwhip effect. This finding

confirms the findings of Govind et al. (2017), who noted that supply chain leaders use demand forecasting management metrics and integrated communication systems to monitor and manage the bullwhip effect behavior within the network.

Correlation to the conceptual framework. This finding aligns with the bullwhip effect theory. Bullwhip effect theorists noted that supply chain leaders should expect some degree of operational disruptions yet, should use effective strategies to mitigate the effects of demand variability and component shortages (Perrow, 1999; Tieman, 2017). Participants' use of communication strategies to reduce operational disruptions is consistent with the findings of Tieman (2017). Tieman found that efficient supply chain managers require steady communication flow between network partners. Cannella et al. (2018) explained that network partners could reduce the gap in information sharing driven by unanticipated demand surge through proactive management of the input and output demand data, adequately vet the data, and timely communicate the information to the network partners. Kache and Seuring (2017) suggested that leaders employ synchronized communication systems, such as a database, to improve information transfer speed and reduce the bullwhip effect.

Theme 3: Component Shortage Reduction Strategy

The third theme that emerged from the participants' data analysis and review of the organizational document was that supply chain leaders used a component shortage reduction strategy to reduce bullwhip effect on their electronic component supply chain. Bounou et al. (2017) acknowledged that the adverse economic consequence of inefficient

operations is the reduction in revenue generation that stems from component shortages and production waste in the form of idle employee time. Moraitakis et al. (2017) noted that lead-time, shortage gaming, and order batching are the driving factors that amplify the bullwhip effect within the supply chain network.

All participants noted how expediting activities driven by component shortage escalations consumed significant financial and human resources, and led to excess inventory at all levels of the network process steps. Participants discussed the use of joint decision-making with network partners to reduce component shortage drivers, minimize escalations, and effectively manage inventory levels thereby, reduced bullwhip effect. By reviewing participants' responses and supporting documents, I determined that the supply chain leaders used a variety of tactics to manage their component shortage reduction strategy. All five participants discussed component shortage reduction strategy from the perspective subthemes consisting of lead-time and cycle time, multisourcing, process integration, technology innovation and flexible manufacturing, factory capacity and equipment prioritization, operational cost reduction, , and logistics management. Table 4 displays the subthemes of the component shortage reduction strategy used by leaders to manage demand variability and reduce the bullwhip effect.

Table 4

Subthemes of Component Shortage Reduction Strategy

Subthemes	Percentage of use by companies

Lead-time and cycle-time	100%
Process integration	100%
Technology and flexible manufacturing	100%
Factory capacity and equipment prioritization	100%
Operational cost reduction	100%
Logistics management	100%

Lead-time and cycle-time. All five participants discussed component lead-time and manufacturing cycle time management. I used the participants' process flowchart document to support lead-time and cycle time management as a subtheme an integral part of component shortage reduction strategy. All five participants discussed the importance of using a multi-sourcing approach to achieve faster recovery during the operational disruption, reduce component shortages, improve lead-time and manufacture cycle time, and reduce bullwhip effect. P1, P2, and P5 saw significant value in the use of information sharing, end-to-end process visibility, and buffer stock programs to improve lead-time and cycle time, minimize shortage escalations and reduce bullwhip effect. P5 stated, "We increase raw material buffer up to a certain percentage to cover for the forecast inefficiency." Component lead-time and manufacturing cycle-times are key contributors of electronic component shortages, which trigger the bullwhip effect (Govind et al.,

2017). Cannella et al. (2018) confirmed the finding and stated that variable factory capacity utilization leads to loss of productivity.

P3 and P4 explained that their multisourcing strategy involves the use of internal and external manufacturing factories for their wafer fabrication, packaging, and testing. P3 explained that 80% of components manufacturing occur internally but heavily use subcontractors to multisource some components, especially during unanticipated demand surge. P3 stated, “We do most of our manufacturing internally. I would say about 80% of our manufacturing is done internally. We use the multisourcing strategy to respond to demand surge that we’re not expecting.” P4 discussed the success in the use of the multisourcing approach to ensure component availability for the consumer, commercial, industrial, and automotive customers. P4 stated,

> We have buffer strategies all the way back to raw material, raw wafers, and the after-fabrication process. We use outside consultants to analyze the forecast variability verses actual demand to determine the appropriate buffer strategy to use at that stage of the fabrication process.

The multisourcing approach played a crucial role to improve lead-time and cycle time, reduce shortage escalations, and dampen the adverse implication of the bullwhip effect. This finding confirms Botha et al. (2017) in that unpredictable component availability could negatively affect the on-time delivery, triggering the bullwhip effect and leading to end-customer dissatisfaction. This finding confirms the research of Isaksson and Seifert

(2016) in that a surge in consumer demand prolongs component lead-time and the manufacturing cycle; therefore, amplified the bullwhip effect.

Process integration. The five participants explained process integration as a part of their component shortage reduction strategy. I used participants' integrated operational process flowcharts document to support process integration as part of component shortage reduction strategy. P1, P2, and P3 implemented integrated inventory optimization system that measures forecast volatility, as well as alert partners to provide better inventory buffer targets per component type. P1 stated,

> We have these rules that we use to establish an inventory target level. We establish those targets using parameters, such as manufacturing cycle time, demand forecast, and inventory buffer level. The buffer level stems from different rules, such as product life cycle stage, ramping, stable, or end-of-life. We have a built-in program in our operational system that we use to trigger a manufacturing halt to reduce the accumulation of excess inventory.

The three participants expressed achieved success in the use of process integration as a strategy to ensure component availability and reduce bullwhip effect. This finding confirms Jaradat et al. (2017) in that supply chain leaders use process integration as a strategy to influence operational visibility to minimize component shortages and reduce bullwhip effect. In agreement with this finding, Ma Gloria (2017) noted that an integrated process facilitates joint decision-making, improves responsiveness that reduces

component shortage concerns during unanticipated demand surge, and dampens the bullwhip effect triggers.

P4 and P5 noted process integration as a strategy to create operational visibility from component demand planning and wafer starts at factories to device packaging and test. P4 and P5 expressed the success in the use of process integration to minimize component shortages and bullwhip effect reduction. P4 employed early engagement with partners to position raw wafers and use the integrated process to trigger wafer start driven by vetted customer demand, hence eliminating the gap in information sharing which helped to minimize shortages and reduce bullwhip effect. P5 used process integration to achieve direct engagement with suppliers to plan manufacturing capacity and resource availability and utilization efficiency. P5 confirmed that direct supplier engagement was successful in influencing effective capacity utilization, mitigate shortage escalations, and reduce bullwhip effect triggers. This finding confirms the research of Mishra et al. (2017) in that process integration facilitates real-time information sharing with internal and external network partners. Effective information sharing reduces redundancies and bullwhip effect. This finding confirms the findings of Nunan and Di Domenico (2017) in that successful supply chain leaders use process integration to manage bullwhip effect threats and reduce the adverse implications of component shortage escalations.

Technology and flexible manufacturing. All five participants discussed the use of technology innovation and flexible manufacturing to reduce the bullwhip effect. I used participants' basic product technology and flexible manufacturing documents to support

technology and flexible manufacturing as an integral part of a component shortage reduction strategy. P1, P2, and P5 noted the value in the use of outsourcing of frontend and backend manufacturing processes to enable supply chain visibility. The supply chain visibility provides the capacity to minimize component shortage escalations and reduces bullwhip effect triggers. The three participants explained the success in the use of flexible backend manufacturing process to respond to unanticipated demand surge, minimize shortage escalations, and reduce bullwhip effect. This finding confirms the research of Sharma et al. (2017) in that supply chain leaders use flexible manufacturing approach to reduce bullwhip effect and improve operational performance. Verhoeven and Johnson (2017) confirmed this finding and added that leaders use outsourcing of some portions of supply chain activities to focus resources on key operational competencies, which provide transparency, minimize component shortages, and reduce the bullwhip effect triggers.

P3 and P4 explained that although specification variations exist, the use of basic technology innovation to serve multiple markets showed success in minimizing component shortages that helped to reduce bullwhip effect. The multiple markets include commercial, consumer, industrial, and automotive market segments. P3 stated, “Our basic technology is similar across multiple market segments, such as commercial, consumer, industrial, and automotive. There are some variations in specifications, but many of our basic product technologies apply to automotive, computing, or industrial customers.” P3 and P4 developed baseline packaging manufacturing flexibility solution

to create several package types and adjust as needed to address amplified bullwhip effect that stems from shortage escalations. This finding confirms the research of Akhtar et al. (2018) in that supply chain leaders use technology innovation and flexible manufacturing to respond to shortage problems and reduce the bullwhip effect. Asadi et al. (2017) found that supply chain leaders use technology innovation and flexible manufacturing to dampen the bullwhip effect on their electronic component supply chain, especially during seasonal market periods.

Factory capacity and equipment prioritization. The five participants discussed the use of factory capacity and equipment prioritization to minimize component shortages and reduce bullwhip effect. I used frontend and backend capacity flexibility versus utilization over time document to support factory capacity and equipment prioritization as part of component shortage reduction strategy. P1, P2, and P5 described the success of using multicapacity modes to flip backend manufacturing processes to reduce lead times while supporting various market cycles. P2 stated, “In the short-term, there is very little flexibility with the wafer process, but we have the flexibility at the back-end packaging process.” The three participants’ responses and the supporting documents indicated the success in the use of multicapacity modes to provide tremendous flexibility, which network partners use to respond to sudden demand surge thereby, minimize component shortage, and reduce the bullwhip effect. Christopher and Holweg (2017) noted that leaders give priority to products with the variable market demand to maintain lead times, reduce shortages, and reduce the bullwhip effect. This finding confirms the research of

Zhang et al. (2017), who promoted the use of factory capacity flexibility in conjunction with equipment prioritization to manage operational performance and reduce the bullwhip effect during unanticipated market fluctuation.

P3 described their capacity to turnover manufacturing equipment in less than one production shift was successful in minimizing component shortages and reduced bullwhip effect. P3 stated,

> We invest in full factory capacity. Full factory capacity means that our forecast must be spot on, but if it is not, we implement a buffer and then expect the forecast to come in exactly. The balance from what we want to do from the utilization standpoint is certainly in the forefront of our minds.

P3 explained that with the equipment turnover capability, the operation could transition an operational line from one type of package to the next kind of package. In doing so, P3 successfully minimized component shortage escalations during demand surge and reduced adverse implication of the bullwhip effect. P4 developed the capability to change factory equipment production priorities quickly. P4 used the equipment reprioritization to mitigate factory line down risks. For instance, when the factory utilization is low, P4 would use the available capacity to set up other operational activities. Alternatively, when the factory gets full, P4 switched to a different mode to maximize capacity throughput, minimize component shortages, and reduce bullwhip effect. This finding confirms Christopher and Holweg (2017) in that successful supply chain leaders use capacity and equipment prioritization to reduce bullwhip effect during unanticipated market

fluctuations. Zhang et al. (2017) confirmed that supply chain leaders use factory equipment prioritization to minimize the challenges associated with excess inventories, idle time, and improve human resources utilization during various market cycle times. Leaders use efficient equipment prioritization to ensure component availability and reduce bullwhip effect.

Operational cost reduction. The five participants discussed the use of operational cost reduction to minimize component shortages and reduce bullwhip effect. I used the participants' inventory buffer stock documents to support operational cost reduction as part of component shortage reduction strategy. All participants explained the financial implications of the bullwhip effect from the perspective of a hidden operational cost associated with shortage escalations, expedites activities, and inventory carrying cost. The five participants noted that the bullwhip effect contributed to the cost associated with factory capacity lost, low productivity, and high operational cost driven by component shortages. All five participants reported that the bullwhip effect was responsible for network partners' need to rehire and retrain human resources driven by market fluctuations. P5 stated,

> We collaborate with our business partners to find optimal solutions to satisfy demand requirements during turbulent market conditions, proposing capacity flexibility opportunities, which limit cost exposure. We remain focused on maximizing opportunities around workweek optimization, providing reasonable

flexibility limits within the boundaries of our social environmental responsibility programs, while striving to remain cost competitive.

The cost associated with scrapped excess and obsolete inventories stems from amplified bullwhip effect due to inventory accumulation. Participants noted that the challenge with unplanned operational cost is lack of ownership of the hidden cost. This finding confirms the research of Madhani (2017) in that adverse economic consequence of inefficient supply chain operation is the reduction in revenue generation that stems from component shortage, lost sales, production waste in the form of idle time, and human resource impact. Li et al. (2017) confirmed that some supply chain leaders spend significant financial and human resources to expedite production activities to ensure component availability and dampen the bullwhip effect.

All five participants discussed how implemented partner accountability played a vital role in operational cost reduction strategy, which facilitated bullwhip effect reduction. P2 stated, “Buffer stock strategy is the best strategy that we use to respond to a short-term change in demand. We work to implement purchasing agreements with customers to establish buffers stock that can be used to smooth the bullwhip effect.” P1, P2, and P4 explained their use of real market demand information to project inventory goals with realistic buffer level added at each process steps. By using real market data, P1, P2, and P4 can accommodate unplanned demand, reduce the backlog, and achieve inventory goal at the end of each quarter while minimizing financial capital spend. This

finding confirms the research of Li et al. (2017) in that the effective management of inventory spending reduces the bullwhip effect and improves operational performance.

P3 and P4 explained the use of partner accountability to manage inventory carrying cost and the adverse financial implication of excess and obsolesce. P3 and P4 used the application of partner accountability to reduce network partners' urge to over buffer inventory. Similarly, leaders used the partner relationship to decide cost ownership. P3 stated, "Who bears the cost of the expedited shipment is dependent on the situation. The situation, such as the relationship with the affected customer and whether we can leverage the opportunity for future business awards." P3 preferred to explore whether they can leverage future business awards rather than pass the expedite cost to the affected customers. This finding confirms Schoemaker and Tetlock (2017), who noted that changes in consumer demand is the driving force behind the market fluctuation. Vatamanescu et al. (2017) noted that for an organization to compete in the ever-changing market, supply chain leaders forge relationships with network partners to reduce component shortages and the bullwhip effect, which are key success factors to gain new customers and customer satisfaction. P4 explained that in most cases, the operation would negotiate a 50/50 split of the expedite cost to sustain the partner relationship and customer satisfaction. This finding confirms the findings of Domański and Adamczak (2017) in that supply chain leaders use a partner accountability approach to mitigate hidden operational cost, ensure component availability, and reduce the bullwhip effect. This finding confirms the research of Negawo and Singla (2017), who noted that close

relationships with business partners streamlines operational activities, and mitigates ambiguities associated with hidden operational cost driven by the bullwhip effect and component shortage escalations.

Logistics management. All five participants discussed logistics management as a strategy to improve operational cost associated with component shortage escalation and reduce bullwhip effect. I used forecast performance waterfall documents to support logistics management as an integral part of operational cost reduction strategy. P1 explained that volume commitment to a constrained product and unrealistic delivery schedule ignites bullwhip effect through the network forcing network partners to respond reactively. P1 discussed that partners' decision to accept last minute business awards with constrained delivery lead-time creates logistic management nightmare, which triggers the bullwhip effect that increases operational cost, and customer dissatisfaction. P1 stated, "We monitor and communicate inventory levels and consumption across our end-to-end supply chain partner process steps." P1 noted the success in the use of effective communication strategy to engage early with network partners to proactively prepare for incoming orders, manage the effect on logistics, and mitigate bullwhip effect triggers. The most notable effect of the component shortage is the constant escalations coming from various dismayed network partners, which triggers the bullwhip effect and logistics management challenges (Jaradat et al., 2017). This finding confirms the research of Mandal et al. (2017) in that component shortage escalations trigger expedite events that

directly affect supply chain logistics, often resulting in increased costs and the need to change the mode of transportation change to ensure customer satisfaction.

P2 noted that the unintended consequences of expediting one customer's product over the other customer are sustaining the lead-time of other customers' product. P2 stated,

> We employ a series of forecasting exercises with the end customer to understand their true demand. It requires very close and frequent communication. The culture within our company is to scrutinize data at a very low level. Collaboration with the supplier is the best approach to solving the bullwhip effect. Trust between partners is critical.

Hence, the P2's corporate culture emphasized the use of data scrutinization approach to reduce bullwhip effect. P2 business partners' appreciation of the data scrutinization concept facilitated the ability to proactively manage logistics phenomenon, mitigate bullwhip effect triggers, which resulted in overall operational performance improvement. This finding confirms Erol and Nakiboglu (2017) in that effective management of customer demand surge would stabilize component lead-times at an acceptable level, reduce threatening risk of component allocation and dampen bullwhip effect. Zhu et al. (2017) noted the importance of information sharing within the supply chain network. The participants used information sharing to provide end-to-end visibility of vetted demand requirements, available manufacturing, lead-time, and logistic constraints. Broad

information sharing minimizes order rationing, reduce bullwhip effect, and improve operational performance.

P3 discussed that the process step that created logistic delay occurs between the factory final process step and distribution receiving process step. P3 stated, “We are still challenged with gaining an accurate forecast process during the transition point between business award, ramp, and production phase. We focus on how we can resolve the disconnect in that core critical point.” The time lag sometimes causes mode of transportation change by shipping product on the next flight out or hand carry product because of a missed opportunity to take the products right off the truck to meet planned shipment schedule. P3 explained that the process delays the opportunity to achieve the planned shipment schedule for urgent orders. P3 added an alert to the logistic systems so that critical components will scan as rush orders at the distribution center. The human resources at distribution would then pull those orders first and prepare them for FedEx 2-day delivery to reduce the cost associated with a change in transportation mode.

P4 explained that the hidden cost associated with expedite activities negatively affected their operational performance. P4 stated,

> In some cases, we pay a premium to expedite things in the factory. We would frequently put folks on planes to carry the material to the customers. Our experience tells us that usually the first shipment is the most important shipment and the ones after that have a little less stress on the customer side.

P4 noted that their use of partner accountability to manage to expedite related cost. The employed partner accountability policy significantly reduced unnecessary expedite related escalations, reduce bullwhip effect and improved operational performance. This finding confirms the findings of Shukla and Naim (2017), who noted that an efficient logistic process would improve revenue generation, minimize escalations, and reduce the bullwhip effect. Ma Gloria (2017) confirmed the finding and advocated effective logistic management as an effective strategy to improve operational performance by reducing the hidden cost associated with expedite activities. P5 noted the premium cost associated with expediting frontend factory processes. P5 explained that the expedite challenge relates to lack of ownership for the cost impact. Part of the operational cost reduction includes implementing a faster information sharing system to provide transparency to enable logistics providers to use a simple click of the computer mouse to share cost related information (Schoemaker & Tetlock, 2017). This finding confirms de Freitas Almeida et al. (2018) in that successful supply chain leaders use IT-enabled infrastructure to reduce operational waste, optimize processes to reduce bullwhip effect, and achieve overall operational performance.

Correlation to the conceptual framework. This finding is particularly relevant to the bullwhip effect theory. Bullwhip effect theorists noted that supply chain leaders use continuous process improvement strategies to reduce the negative effect of market fluctuations on organizations' economic sustainability (Coase, 1937). Bounou et al. (2017) found that IT companies experience negative economic consequences of

inefficient operations, such as lost sales that stem from component shortages and a loss of employee productivity. Hence, it is imperative for supply chain leaders to use continuous process improvement strategies to improve component lead-time and manufacturing cycle times to reduce shortages, which sometimes triggers the bullwhip effect (Govind et al., 2017).

Theme 4: Resource Management Strategy

The fourth theme that emerged from the analyzed data was that participants used an effective resource management strategy to reduce the bullwhip effect on the electronic component supply chain. Ingy Essam (2017) noted that implementing a resource management strategy is an effective means for supply chain leaders to improve operational performance, systems capabilities, and information communications, all of which result in bullwhip effect reductions. Marhamati et al. (2017) offered that supply chain leaders could use IT systems to source electronic components from low-cost countries and distribute the components across several regions to mitigate component shortages and reduce bullwhip effect. By reviewing participants' responses and their supporting documents, I noted that each participant used a resource management strategy based on the environment and operational need. The five participants discussed resource management strategy from the perspective of IT systems and human resources subthemes. Table 5 displays the subthemes of the resource management strategy used by leaders to integrate operational network system asserts, improve human resource engagement, and reduce the bullwhip effect.

Table 5

Subthemes of Resource Management Strategy

Subthemes	Percentage of use by companies
IT systems	100%
Human resources engagement	100%

Information technology system. All five participants discussed the application of IT technology to reduce the bullwhip effect. I used the participants' strategic supply flexibility plan and forecast performance waterfall to support effective resource management as a strategy to reduce bullwhip effect. The five participants discussed how integrated IT systems was used to centralize major operational activities such as forecast, demand planning, market intelligence, and information sharing and other critical value chain initiatives. P1 and P3 conceded that the switching cost of implementing major IT infrastructures was a limiter, but they were able to integrate critical operational processes, such as inventory, production, order management, and financial reporting systems.

P1, P2, and P5 discussed the utilization of IT-enabled inventory optimization systems to monitor and manage component demand and supply variability, and then use the IT-enabled systems to communicate inventory information to the network partners. The three participants noted the benefit the network gained from using optimized strategy to reduce bullwhip effect and improve operational performance. P2 explained their key

differentiator in the use of strong relationship partners to manage bullwhip effect triggers at all process steps of the electronic component supply chain. P2 stated,

> I would say that our number one differentiator in managing severe supply chain issues is strong relationships with key managers in the sourcing and engineering group. When both customers and suppliers are working as a team to solve problems, the business grows stronger.

P2 noted that when both customers and suppliers work as one team to reduce bullwhip effect implications, the businesses would grow stronger resulting in customer satisfaction, revenue generation, and competitive advantage. This finding confirms the findings of Botham et al. (2017) in that the use of IT-enabled systems would help to improve operational performance by minimizing the gap in information sharing, which would translate to a bullwhip effect reduction. This finding confirms the findings of Park (2017) in that the use of the IT-enabled system would improve communication speed, which is vital to reduce the bullwhip effect during unanticipated demand surge driven by market fluctuation.

P3 and P4 explained the use of IT-enabled systems to capture demand for new product release, and then used the integrated communication systems to feed the confirmed demand information to the factories for wafer start. Concurrently, the factory partners would use the input demand information to build wafers up to die point. P3 stated,

> We try to provide order execution information systematically rather than verbally. We try to communicate that information to customers as quickly as possible. With the system, we can put the allocation at the bank level and that aligns the system all the way back to the wafer start.

The system would flag a postponement at the die process point pending customer order confirmation. P3 noted the implementation and adoption of Kinases rapid response demand planning engine, which runs several forecast scenarios within a quick turn-around time. P3 discussed that their key competence is to use supply chain strategies to reduce bullwhip effect, improve operational performance, and gain a competitive advantage by differentiating their brand in the marketplace.

P4 discussed the application of Oracle Demantra system through Tata consultant services to manage demand planning, forecasting, and data analysis. P4 stated,

> We used Tata consultant services reimplementing series of our Oracle system that we use for planning, forecasting, and demand data analysis. Where we chose to group like products together, we employ a statistical algorithm to determine which parts belong to which category, so we can level load all the parts that are within a certain acceptable forecast over a period.

P4 noted that products using basic technology and like-packages, operations employ a statistical algorithm to sort and level load the component categories. P4 emphasized their preference to take a holistic view approach to identify and solve the low- hanging fruit problems relevant to the bullwhip effect to prevent the low- hanging fruit from creating

big operational problems in their factories. This finding confirms the research of Nguyen (2017) in that successful supply chain leaders use IT-enabled systems to reduce operational waste caused by bullwhip effect triggers and improve the end-to-end process to gain a competitive advantage. Pataraarechachai and Imsuwan (2017) confirmed this finding as well as recommended the use of the IT-enabled system to promote transparency within the network. Operational transparency facilitates bullwhip effect reduction and ensures component availability.

Human resource engagement. All five participants discussed human resource engagement as an integral part of using resource management strategy to reduce the bullwhip effect. I used supply flexibility plan and forecast performance waterfall documents to support human resources management as a strategy to reduce bullwhip effect. All five participants discussed the impact of social and environmental forces that stem from the overutilization and underutilization of human resource during high and low market months. The five participants noted that the fear of demand uncertainty and component availability adversely affect human capital, which sometimes exhibits in the form of amplified bullwhip effect and poor operational performance. P2 stated, “Very close relationships and communicating with the end customer is an absolute must.” P2 explained that the network partners’ human resource developed skepticism relative to sudden demand changes coming from some channel partners. P2 explained the benefit of leveraging improved employee engagement and effective communication strategies to smooth demand fluctuation on all levels of their operational environment, which in turn

reducing the bullwhip effect and empowers the employees to make effective business decisions.

P3 noted the use of improved supply chain strategies and operational policies to improve human resource engagement. Improved human resource engagement motivated the human network resources to provide effective operational support, which helped to reduce bullwhip effect and improved operational performance. P1, P4, and P5 noted that the network partners' implication includes lack of trust and customer dissatisfaction. P5 stated, "The human impact is quite large ranging from high turnover rate, hiring expense, training, inefficiencies incurred through the learning curve, and employee dissatisfaction." The three participants explained that high and low utilization of the network human resources sometimes results in fatigue, low morale, and increased turnover intent. The three participants noted that improved human resource engagement strategies and implemented operational policies influenced sustained human resource commitment, established trust, and encouraged effective communication up and down the supply chain networks. Ali et al. (2017) found that effective corporate social responsibility and the efficient use of human capital might result in employee longevity that correlates to bullwhip effect reduction and sustained organizational performance. Chowhan et al. (2017) confirmed the finding and noted the importance of using effective human resource strategies to manage emotional effect driven by the social and environmental forces.

Correlation to the conceptual framework. This finding aligns with the bullwhip effect theory. Bullwhip effect theorists attributed operational disruptions to uncertainty within the operational environment and unpredictable market condition (Arora, 2016). Participants' use of resource management strategy to reduce the bullwhip effect is consistent with the findings of Chowhan et al. (2017), who noted that effective resources management need to occur at every operational process steps of the supply chain management. The IT systems used to provide visibility to minimize overutilization of human resources require adequate resource management strategies to sustain the effectiveness to reduce bullwhip effect (Hong et al., 2017).

Applications to Professional Practice

The leaders' ability to use effective supply chain strategies to mitigate the triggers of operational disruption within the network drives the success in reducing bullwhip effect in the electronic component supply chain (Uca et al., 2017). Supply chain leaders used a collaboration strategy to establish sustained trust among business partners through end-to-end operational process alignment, which resulted in bullwhip effect reductions. Leaders of IT supply chains could apply market forecast insights from analysts and network partners to use realistic predictions of the long-term forecast to reduce bullwhip effect drivers. Supply chain leaders use end-to-end approach to mitigate the adverse implication of bullwhip effect on their operational environment (Moraitakis et al., 2017). Supply chain leaders might apply the findings of this study to use an improved end-to-end collaboration strategy to reduce the bullwhip effect and achieve optimum operational

performance, effective utilization of resources, and social and environmental sustainability. The application of these findings by leaders might improve the effectiveness of the collaboration and communication strategies used to align operational process imperatives within network partners. Supply chain leaders might use the integrated operational processes to influence the reduction of the bullwhip effect in the electronic component supply chain.

Supply chain leaders use an effective communication strategy to achieve bullwhip effect reductions through the application of beer game simulation, inventory level monitoring, and forecast management. Supply chain leaders might apply the findings of this study to assess the internal and external communication strategy and use the beer game simulation to reduce gaps in information flow to facilitate the use of sustained end-to-end communication strategy to reduce the bullwhip effect. The supply chain leaders' careful management of the electronic component forecast variability through inventory level monitoring at each process step increased the leader's ability to reduce the bullwhip effect (Moraitakis et al., 2017). Supply chain leaders might use the inventory level monitoring strategy to effectively communicate short-term and long-term demand, as well as align actual demand data to supply availability at each process step of the network to minimize the bullwhip effect triggers. Supply chain leaders use the efficient forecast management system to improve the end-to-end communication speed relative to component availability to reduce bullwhip effect and sustain customer satisfaction (Botha et al., 2017). IT supply chain leaders may use forecast management systems to evaluate

network forecast data and determine a wafer start schedule to reduce the bullwhip effect and meet customer demand.

The supply chain leaders used component shortage reduction strategy to reduce the bullwhip effect in the electronic component supply chain. The leaders used the effective implementation of lead-time and cycle-time management, process integration, flexible manufacturing, factory capacity, equipment prioritization, operational cost reduction, and logistics management to reduce bullwhip effect drivers significantly. Supply chain leaders might use component shortage reduction strategy to minimize the adverse implication of long lead-time and cycle-time on operational performance through the reduction of the bullwhip effect. The sustainability of operational performance requires the use of end-to-end process integration to influence frequent network collaboration and communication speed to dampen the bullwhip effect (Govind et al., 2017). Supply chain leaders may use the findings of this study to implement process integration to facilitate real-time demand data sharing with network partners to reduce bullwhip effect driven by component shortage concerns during unanticipated demand surge.

Supply chain leaders use technology innovation and flexible manufacturing strategy to serve multiple markets and mitigate component shortages thereby, reduce the bullwhip effect in the electronic component supply chain (Zhang et al., 2018). Supply chain leaders might apply the findings of this study to implement technological innovation and flexible manufacturing to support various market cycles and reduce

bullwhip effect drivers. Supply chain leaders use factory capacity flexibility and equipment prioritization to manage variable market products to minimize lead-time variability and reduce bullwhip effect (Christopher & Holweg, 2017). Leaders of IT supply chain might apply the findings of this study to implement factory capacity flexibility and equipment prioritization to achieve faster recovery and reduce bullwhip effect triggers driven by component shortage during market fluctuation.

Supply chain leaders use efficient operational management strategies to mitigate bullwhip effect triggers, such as component shortage, lost sales, production waste in the form of idle time, and human resource impact (Madhani, 2017). Supply chain leaders might apply the findings of this study to implement continuous process improvement strategy to achieve operational cost reduction and reduce adverse implication of bullwhip effect driven by market fluctuations. Leaders use effective logistic management to reduce bullwhip effect driven by component shortage escalations from unhappy customers (Jaradat et al., 2017). Supply chain leaders might apply the findings of this study to implement effective logistics management strategy to minimize hidden operational cost linked to component shortage escalations and reduce the bullwhip effect driven by unhappy customers.

Supply chain leaders used resource management strategy to reduce bullwhip effect triggers through the implementation of effective IT systems and human resources engagement. Leaders of IT supply chain use IT-enabled technology infrastructure within the resource management strategy to reduce the bullwhip effect (Botham et al., 2017).

Supply chain leaders might apply the findings of this study to use IT systems to centralize their critical operational processes, such as forecasting, demand planning, inventory accumulation, production activities, order management, and financial reporting tools to reduce bullwhip effect. Supply chain leaders use efficient corporate social responsibility to improve human resource engagement that results in employee longevity, which correlates to sustained organizational performance (Ali et al., 2017). Supply chain leaders might apply the findings of this study to implement operational policies to influence sustained human resource commitment, trust, and effective communication up and down the network to achieve smooth operation on all levels of the operational environment to achieve bullwhip effect reduction.

Implications for Social Change

The potential for increased use of sustainable supply chain strategies to reduce the accumulation of excess and obsolete inventories, transportation fuel usage, and the consumption of storage-related and natural resources are the social change implications of this study. Effective supply chain leaders use a holistic approach to respond to operational disruptions, engage in real-time responses to mitigate shortage escalations and reduce the organization's annual spending on excess component inventory, which results in a desirable social change (Govind et al., 2017). Successful IT organizational leaders use efficient supply chain strategies to differentiate their brand, sustain their market position, and gain a greater share of the new market to achieve competitive advantage. Society might benefit from the findings of this study because of the use of

technology innovation and flexible manufacturing strategies to reduce the accumulation of excess inventories, inventory obsolescence, reduce transportation fuel usage, and the consumption of storage-related and natural resources, which improves environmental sustainability.

The leaders can minimize operational waste and improve employee work efficiency through the implementation of useful bullwhip effect reduction strategies. The leaders use of an IT-enabled system for collaboration and communication within the network results in increased sustainability of social, economic, and environmental change that leads to competitive advantage (Botha et al., 2017). Supply chain leaders can use effective collaboration strategies to sustain end-to-end operational policies and improve economies of scale while conserving natural resources. Therefore, leaders could use the finding of this study to create efficient component sourcing strategies, improve their business practices from social change to financial, operational, and cultural change. The consumer advocate of global warming awareness strategically uses their business award to patronize supply chain organizations that demonstrated social and environmental change sustainability (Hsu et al., 2016). Leaders who achieved sustainable socially responsible supply chain operations through effective resource management strategies gain access to demand-driven innovation and product development opportunities. The use of supply chain strategies to reduce the complexities of managing demand, supply, and logistics in a multiechelon supply chain environment might help to retain skilled employees (de Freitas Almeida et al., 2018). Human resources provide skills and

competencies to achieve sustained socially responsible business practice, performance, and competitive advantage. Hence, leaders might use an improved human resources engagement strategy to reduce the emotional effect driven by operational social and environmental forces.

Recommendations for Action

The purpose of this qualitative multiple case study was to query supply chain strategies used by successful leaders to reduce the bullwhip effect. I recommend that supply chain leaders use collaboration strategy to achieve supply chain operational efficiencies and reduce hidden operational cost. Supply chain leaders used various collaboration strategies to influence network partner agreements and information sharing policies to build trust among their network partners, which reduced the bullwhip effect. I recommend that supply chain leaders use effective communication strategies to mitigate the adverse implication of the bullwhip effect.

Supply chain leaders achieved success in reducing bullwhip effect through their unique application of communication strategies. I recommend that supply chain leaders use component shortage reduction strategy to reduce the bullwhip effect associated with component shortages. Supply chain leaders found success in the use of joint decision-making to manage and mitigate component shortage drivers, which effectively reduce the bullwhip effect. I recommend that supply chain leaders use resource management strategies to reduce the bullwhip effect implications on their electronic component supply chain. Supply chain leaders achieved success in the use of IT systems and human

resource management strategies to reduce the bullwhip effect, achieve operational performance, and gain a completive advantage.

Researchers endeavor to publish the findings of their study in quality academic journals and contribute to the body of knowledge (Hangel & Schmidt-Pfister, 2017). I intend to contribute to the body of knowledge through scholarly literature in the areas of supply chain management. I intend to develop an article to submit for publication in the following peer-reviewed journals: (a) *Journal of Supply Chain Management*, (b) *Journal of Operations Management, (c) Journal of Purchasing and Supply Management*, (d) *American Journal of Supply Chain Inventory*, and (e) *International Journal of Logistics Management.* Also, I have identified two supply chain conferences that I will submit a presentation for the opportunity to present at the conference. I will submit a proposal to present at the American Supply Chain Summit and Supply Chain World.

Recommendations for Further Research

A limitation of this study was the sample population of five IT supply chain leaders who implemented strategies to reduce the bullwhip effect. Future researchers could expand the scope of this study in a manner that would encompass a more general population to gain additional insight. Future researchers should consider conducting a study with a different population of IT supply chain leaders that rely on the use of supply chain strategies to manage their operational activities, and then compare the outcome of their study to the findings of my study. Future researchers could conduct multiple case studies to explore the strategies other leaders in the retail, service, and food supply chain

industries used to reduce bullwhip effect. Another limitation of my research was the geographic region of the state of Texas. I recommend a future researcher to conduct an additional study to explore strategies leaders used to reduce the bullwhip effect in other regions where corporations operate global supply chain management. The transferability of the findings of this research by future researchers in other settings or organizations was a limiter of my study. Future researchers could use a mixed-method approach to explore the strategies and statistically evaluate the financial consequence of the bullwhip effect on the electronic component supply chain.

Reflections

I have 22 years of professional experience in IT industry. My experience includes research and development, procurement, engineering program management, and strategy and planning. I am a Lean Six Sigma Black Belt, and Project Management Professional certified. Nevertheless, my experience with the doctoral process challenged me beyond my expectations. My participation in the doctoral program offered a holistic view of supply chain management requirement and the complexities associated with managing business imperatives within a global network. I leveraged my multiple year's exposures in a supply chain environment coupled with my doctoral program experience to explore strategies supply chain leaders used to reduce the bullwhip effect on their electronic supply chain. To mitigate bias because of my prior supply chain experience, I used multiple techniques to bracket my lens. I used the interview protocol (see Appendix B) and the same open-ended questions (see Appendix A) in the same order in a

semistructured setting to conduct my participant interviews. I used member checking to validate the accuracy of my transcription of the participant's responses. I used each participant's organizational website to collect supporting documents and achieve data saturation for my study. Nevertheless, I was surprised to learn that one supply chain leader integrated the beer game program into the corporate culture and employ beer game as a communication strategy to reduce the bullwhip effect on the electronic component supply chain. Another surprising factor for me was the fact that some of the supply chain leaders use inventory level monitoring as part of their communication strategy.

Conclusion

The corporate leaders of the IT industry seek to use their supply chain organizations to gain global presence and competitive advantage. Supply chain leaders face the challenge of identifying the appropriate strategies to mitigate the bullwhip effect triggers and reduce the adverse implication on their component supply chain network. The purpose of this multiple case study was to explore the strategies successful supply chain leaders use to reduce the bullwhip effect. Utilizing the bullwhip effect theory to ground my study, I collected data from five IT supply chain leaders and manufacturing cycle flowcharts and capacity flexibility plan documents, inventory buffer stock plan, and forecast performance waterfall documents, and the beer game simulation video. I used five data analysis phases to analyze my research data. The five-step data phases are consistent with Yin's (2015) recommended data analysis approach that includes data: collection, stratification, reassemble, interpretation, and conclusion. The four key themes

that emerged were: (a) collaboration strategy, (b) communication strategy, (c) component shortage reduction strategy, and (d) resource management strategy. The implications for positive social change include the potential for leaders to use effective supply chain strategies to reduce the accumulation of excess inventories, reduce transportation fuel usage, and the consumption of natural resources, which improves environmental sustainability. Supply chain leaders may use effective collaboration, communication, component shortage reduction, and resource management strategies to reduce the bullwhip effect, improve their profitability, increase customer satisfaction, and gain competitive advantage.

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Appendix A: Interview Questions

1. What effect did the bullwhip phenomenon have on electronic component sourcing strategy?
2. What strategies did you use to reduce the bullwhip effect in your supply chain?
3. What strategy did you use to manage electronic component shortage escalations?
4. What strategy did you use to manage excess electronic component inventory?
5. What strategy did you use to manage aged or obsolete electronic components?
6. What effect did the electronic component shortages have on delivery strategies?
7. What barriers did you encounter to implementing the strategies for reducing the bullwhip effect on your supply chain?
8. How did you address the barriers to implementing the strategies for reducing the bullwhip effect on your supply chain?
9. How did you assess the effectiveness of your strategies for reducing the bullwhip effect on you supply chain?
10. What additional information regarding strategies to minimize the bullwhip effect on your supply chain would you like to add?

Appendix B: Interview Protocol

Interview preparation:

I will use e-mail to introduce myself, invite potential participants, and provide an informed consent form to the potential research participants. Sending informed consent form in advance will afford the participant enough time to review the content, make an informed, autonomous decision, as well as use e-mail to provide their participation intent. The goal of using informed consent form is to ensure that participants understand the implication of their participation and that their participation will be unpaid and uncompensated.

Business: _____

Participant (Title): _____

Interview Date_____

Interview Time_____

Organization _____

1. **The informed consent form**

   I will use e-mail to send the informed consent to the potential participants in an attachment to the Invitation to Participate e-mail. On the day of the interview, I will:

   a. Confirm that the participant understands the consent form to ensure that he or she had time to read the content and understood the benefit, risks, and voluntary nature of their participation.
   b. Reassure the participant that his or her participation and responses are confidential and the published doctoral study will not include any recognizable information to protect their identity.
   c. Ask if he or she have any question about the content of the informed consent

d. Ask the participant about their willingness to move forward with participating in the interview.

2. Opening the interview

To start the interview, I will:

a. Greet and welcome the participant
b. Thank the participant for their time and willingness to participate in my research study voluntarily
c. Introduce myself and my school
d. Provide a quick overview of my research topic
e. Highlight the potential study benefits to business practice and social change
f. Advise that the interview will take approximately 30-45 minutes

3. Starting the interview

Before starting the interview, I will:

a. Inform participant that I will record the interview for transcription purposes, as well as take notes to document any reflexive thoughts that I might have while he or she is talking
b. Ask participant if I have his or her permission to record the interview
c. If the participant chose not to participate in audio recording the interview, I would tell the participant that I would do my best to take written notes of his or her valuable information to ensure that I adequately capture their responses.
d. Start the audio recording if the participant approves the audio recording request.
e. Advise participant that he or she may withdraw the informed consent at any time during the interview

4. Conducting the interview

I will inform participants that I will ask open-ended questions. Additionally, I will

a. Advise participant to feel free to use clarifying explanations to express their views
b. Advise participant to feel free to decline to answer any question that he or she is not comfortable answering.
c. Begin the interview by asking the documented open-ended questions
d. Follow up with probing questions for additional information and clarity after receiving the primary response to the open-ended question

5. Ending the interview

Upon the completion of the interview, I will:

a. Reaffirm the confidentiality nature of the participant responses, the safeguarding of their privacy, and the protection of their identification.
b. Inform participant that I will use codes 1-5 to represent their names for sequential interpretation of the information he or she provided.

c. Express my appreciation for the participant time and willingness to participate in the study voluntarily.
d. Advise participant that I will send a 1-2 page interpreted summary of the interview responses for him or her to verify the accuracy of my interpretation
e. Inform participant that schedule time to meet with him or her in 3-5 days to engage in member checking to obtain any additional information they might offer.

Appendix C: Invitation to Participate in a Bullwhip Effect Research Study

Date:

Dear (name):

My name is Augustina Onuoha; I am a doctoral student at Walden University. I am preparing to conduct a research study to explore strategies information technology (IT) supply chain leaders used to reduce demand and supply variability (also known as the bullwhip effect) in their electronic component supply chain network. I identified you as a potential participant through a review of trade publications, such as the Gartner Supply Chain Top 25 and Supply Chain World. I am inviting supply chain leaders who meet the eligibility criteria to participate in this research study.

The eligible criteria to participate in my research study are (a) supply chain leaders, (b) employed by IT companies in Houston, Texas, and (c) who successfully implemented strategies to reduce the bullwhip effect on their electronic component supply chain. If you meet the eligibility criteria, I will request for an interview session lasting for 30-45 minutes, and a 30-minute follow up meeting for you to review my interpretation of your responses during the interview.

Please note that participation in this study is voluntary. I am not offering any form of compensation for participating in the study. I will provide participants a 1-2 page executive summary of the findings of this study.

I have attached an informed consent form to this email to further explain the interview process, address confidentiality, and privacy concerns before the interview. Please read the informed consent form carefully and ask any questions you may have before making a decision to participate. You can contact me via email at [redacted] or by telephone at [redacted]. If you meet the eligibility criteria, would you be willing to participate? After reading the informed consent form, and you may provide your agreement to participate in this study by replying, “I consent” to this email.

Best Regards,

Augustina (Tina) Onuoha
[e-mail address redacted]
[telephone number redacted]