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Strategies Automotive Purchasing Managers Use for Managing Material Costs

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Walden University

College of Management and Technology

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Obundah C. Wenah

has been found to be complete and satisfactory in all respects,
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Walden University
2022

Abstract

Strategies Automotive Purchasing Managers Use for Managing Material Costs

by

Obundah C. Wenah

MBA, Wayne State University, 2016

BS, Rivers State University, 2005

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

July 2022

Abstract

Business leaders continually face challenges with the rising cost of materials. Automotive purchasing managers need to develop strategies to manage the cost of materials.

Grounded in resource dependency theory, the purpose of this qualitative multiple case study was to explore strategies purchasing leaders in the automotive industry use for managing material costs. Data collection included semistructured interviews and documentation, including purchasing policies and directives. The participants comprised four automotive purchasing managers who formulated and implemented material cost strategies. Five themes were identified using thematic analysis: (a) negotiation, (b) total cost of ownership, (c) reducing design complexity, (d) supplier strategic relationship, and (e) role of information technology. A key recommendation for purchasing managers is to use third-party sources to benchmark materials prices and utilize cost engineers to calculate and analyze the total cost of ownership of critical materials purchased by the firm. The implications for positive social change include the potential to develop sustainable partnerships with local companies to help create jobs for residents of the area and support local social programs.

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Dedication

I dedicate this study to my dear mother, Lady Rosa Ogonda Wenah, who passed on a few weeks to the completion of my doctoral program. It was her desire that I complete the program, and she encouraged me through the rigors of the process. I am sure she would have been proud to see me graduate from the program. Thank you, mum, for believing in my ability to reach the finish line and for your constant prayers. I will always love you.

I dedicate this study to my lovely wife, Homa, for holding the family together while I was studying through the night or spending long hours in the library. I appreciate her understanding and support during my absences from family time, social events, and dinner dates. Additionally, I dedicate this study to my children, Obuchim, Omasirichim, Okechim, and Ogechi, for their understanding during my absence from movie nights and family dinners. The support and encouragement that I received through the process were immeasurable.

Lastly, I dedicate this study to my father, Tom Wenah, who instilled discipline in me and taught me the importance of education. My father has been my mentor, and he has shaped my life in many ways. Thank you, dad.

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Finally, I would like to thank the participants of this study for their willingness to participate and share important information with me. I cannot thank the participants enough for spending time with me despite their busy schedules to authenticate this research. God bless you all.

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Section 1: Foundation of the Study

Supply management is the process of sourcing raw materials or services required for production. Yazdani et al. (2017) described supply management as a process with a complete set of activities wherein raw materials are transformed into final products. After that, the final products are delivered to customers by processes related to distribution, logistics, and retail. Purchasing raw materials is a critical resource for the production or manufacturing of final products. Purchasing managers are faced with the responsibility of managing material costs and managing supply management uncertainties. The intricate role of purchasing managers in an organization has caused a shift from a tactical or operational functional position to a strategic position. Supply management is an essential field in business because it reduces risk in the supply networks through effective logistics, capacity, and supplier management.

Background of the Problem

As organizations race to be the leader as either a low-cost provider or to gain first-mover advantage, they rely on their supply network's efficiency to deliver on promises to stakeholders. For example, industry experts ascribe the successes of major companies like Apple and Amazon to their sustained leadership and prowess in supply management (Lee & Schmidt, 2017). Additionally, automotive industry product launch successes are attributable to strategic supply partnerships (Zaremba et al., 2016). While other functions like marketing and engineering impact sales by responding to the customer's voice, the purchasing function impacts the bottom line by reducing costs. Purchasing managers protect the firm from unexpected threats in either price increases or supply disruptions.

Risks that can arise due to raw material shortages affecting one or more suppliers in the value chain can be identified and managed by an efficient supply management system. Also, raw material shortages may result in price increases and the nonavailability of purchased materials and supplies, leading to downtime in the production plant. Therefore, firms take proactive steps to monitor and manage changes in the supply chain to reduce disruptions. As a result, purchasing managers use diverse strategies to monitor, manage, and minimize both costs and supply chain risks.

Disruptions in the supply chain can occur in response to increasing demand, evolving technology, and unpredictable events such as COVID-19 or natural disasters (Ivanov, 2020). Uncertainties in markets' growth and dynamics of markets affect product life cycles (Bidhandi & Valmohammadi, 2017). Designing and tailoring the appropriate supply management strategies for lower cost and timely delivery is critical for the supply chain. The overall purchasing function goal is to be proactive by improving flexibility, developing supply partnerships, eliminating the bullwhip effect, and creating long-term plans. An organization's ability to quickly adapt and respond to environmental changes and market conditions are indicative of a resilient and effective supply management system.

Problem and Purpose

The future prospects of both existing and new mobility services in the automotive industry will be dependent on production costs (Becker et al., 2020). An analysis of the production cost in the automobile industry showed that material cost accounts for more than 50% of the total cost of production, and a reduction in material costs could increase

companies' economic viability (Klünder et al., 2019). The general business problem is that poor cost management reduces the economic viability of a company. The specific business problem is that some purchasing managers in the automotive industry lack strategies for managing material costs.

The purpose of this qualitative multiple case study was to explore strategies purchasing managers use for managing material costs. The targeted population consisted of purchasing managers from four automotive companies in Detroit, Michigan, who have successfully implemented material cost strategies. The implications for positive social change include developing sustainable partnerships with local companies that will help create jobs for residents of the area and support local social programs.

Population and Sampling

The population for this study was purchasing managers in the automotive industry in the United States. For this study, the purchasing managers were executives at the helm of affairs in the organization and responsible for making purchasing decisions. The sample size consisted of four purchasing managers from four different automotive companies. Participants had been in the field of purchasing for about 5 years. The targeted population consisted of purchasing managers of automotive companies in Detroit, Michigan, who have successfully implemented material cost strategies.

Nature of the Study

I selected the qualitative method for my doctoral study. Qualitative research is essential for analyzing a specific situation in greater depth and detail (Sayem et al.,

2019). The qualitative method is a means for exploring and understanding how purchasing managers ascribe strategies for managing material costs (Rahman, 2017). The other research methods, quantitative and mixed methods, were not suitable for this study because they involve closed-ended questions to test a hypothesis (Yin, 2018).

Quantitative research includes statistical data analysis for examining relationships or trends among variables (Bhinder, 2019). Mixed-methods research involves combining the quantitative and qualitative strands to address a specific business problem (McCrudden et al., 2019). I did not test hypotheses to explore strategies for managing material costs, which is an integral part of a quantitative method or the quantitative section of a mixed method. Therefore, the qualitative approach was the most appropriate method for the study.

I considered four research designs for a qualitative study on managing material costs. The qualitative designs include: (a) ethnography, (b) phenomenology, (c) narrative, and (d) case study. Ethnography is about culture, and it involves studying and collecting data on how individuals enact and alter structures by specific actions and social patterns (Berthod, 2017). The ethnographic design was not appropriate because it requires the researcher to be immersed in the participants' daily activities. Researchers use a phenomenological model to understand the meanings of human lived experiences (Seyyed et al., 2020). I did not use the phenomenological model because it involves an in-depth analysis of a phenomenon from the personal meanings of participants' perspectives of experiencing phenomena (Seyyed et al., 2020). A narrative design was not appropriate for this study. The narrative design involves using individuals' written or

spoken words with an emphasis on character either about themselves or about a set of events (Mohajan, 2018). Case study researchers explore participants' real-life experiences or complex processes as they naturally occur within systems or groups (Alpi & Evans, 2019). The case study design was appropriate for my study because it allowed me to take a more holistic approach to qualitative research. I selected a multiple case study over a single case study to explore a broader scope of the phenomenon and to compare findings among the different cases.

Research Question

What strategies do purchasing managers use for managing material costs?

Interview Questions

1. What strategies are you currently using to manage material costs?
2. How did you assess the effectiveness of the strategies?
3. How have your material purchasing strategies evolved?
4. What tools or resources were necessary for effective material cost management?
5. What strategies did you adopt to identify and develop sustainable supplier partnerships?
6. What, if any, supplier resistance did you experience while implementing cost management strategies?
7. What additional information would you like to offer on strategies you apply to manage material costs?

Conceptual Framework

I used the resource dependency theory (RDT) for my research. Pfeffer and Salancik (1979) developed RDT and used RDT to explain how organizational leaders can collaborate with their significant stakeholders or resources to gain business value. The main tenet of RDT is that dependencies between organizations for resources are essential for achieving strategic objectives (Pfeffer & Salancik, 2003). However, the organization with the most access and the most control over resources forms the basis of power (Pfeffer & Salancik, 2003). In the pursuit of resources, organizations need to identify and develop effective, dependable, and sustainable resources. Wolf (2014) suggested that collaboration between supply chain leadership and organization stakeholders increases both the organization and the stakeholder's performance.

The RDT stems from the idea that external factors influence effective material cost management and supplier partnership development (Hillman et al., 2019). The level of dependency on external factors can either make or mar the supply chain's performance. Organizational profitability will depend on its ability to cooperate with stakeholders, acquire required resources, and integrate the resources into its systems and operations. The level of corporate dependence on critical and essential resources from suppliers influences the organization's actions and decisions in managing material costs (Nienhüser, 2008). The more an organization is dependent, the higher the likelihood of uncertainty, and the more likely it is to develop strategies to mitigate or hedge the uncertainties (Nienhüser, 2008). Therefore, RDT was an appropriate conceptual

framework for my study because it helped me understand how businesses can collaborate effectively to avoid uncertainties and reduce material costs.

Operational Definitions

The definitions for the following terms used in the research have been stated for clarity and to avoid misinterpretation.

Bullwhip Effect: The bullwhip effect is a distribution supply chain phenomenon where order variability increases as the orders move upstream (Alabdulkarim, 2020)

First-mover Advantage: First-mover advantage refers to the advantage that firms who are first to the market can extract high profits prior to the entry of a follower or competition (Flor & Moritzen, 2020)

Global Supply Chain Management: The field of global supply chain management is a process of international sourcing and delivery of raw materials or services (Yazdani et al., 2017)

Purchasing Managers: The primary role of purchasing managers is to develop supply partnerships that reduce uncertainty, costs, bullwhip effect, and long-term plan (Gadde & Wynstra, 2018)

Supply Chain Sustainability: A sustainable supply chain is a supply chain in which actions or decisions are taken to preserve the environment and make society better (Mursidah et al., 2020)

Supply Chain Uncertainties: Supply chain uncertainties are the disruptions in the flow of materials or products that can occur on either the demand side or the supply side of the supply chain (Daneshvar et al., 2020)

Assumptions, Limitations, and Delimitations

Researchers choose a research methodology to adopt for the study and the process for data collection. In scholarly research, it is then essential to state the underlying assumptions, limitations, and delimitations related to the study design (Wolgemuth et al., 2017).

Assumptions

A core assumption in this study was that purchasing managers formulate strategies for managing material costs, and they would be willing to share those strategies with me. Meriam and Tisdell (2015) described assumptions as the researcher's inherent view assumed to be correct. Yin (2018) stated that in qualitative research, the researcher makes certain assumptions. In choosing a multiple case study and for triangulation, I assumed that participants would give me accurate interview data and reliable company records. Lastly, I assumed that RDT was the appropriate conceptual framework for this study to provide insights into external factors influencing material cost management.

Limitations

This qualitative study involved some limitations. A study's limitations refer to potential weaknesses outside the researcher's control (Theofanidis & Fountouki, 2018). This study was limited to the current strategies used to manage material costs, subject to market strategy changes or corporate strategy changes. I limited the study population to purchasing managers in the US automotive industry. Therefore, the outcome of the study may not be transferable to other sectors or other geographic locations. Due to the

industry's competitive nature and nondisclosure agreements, participants held back sharing extensive company-specific details.

Delimitations

A delimitation of this study includes strategies for managing material costs based on the RDT. Delimitations are essentially the boundaries or limits set by the researcher (Theofanidis & Fountouki, 2018). I could have used other theories for this study that would have led to a different result. However, this study was restricted to studying the impact and management strategies related to organizational dependency on critical resources. Finally, I selected executive management participants who had at least 3 years of experience in that position. Thus, middle-level and front-line managers were excluded from this research.

Significance of the Study

Contribution to Effective Practice of Business

Material cost management in the automotive industry is critical to profitability because a dollar saved in material cost translates to a dollar gained in profit. Purchasing managers are responsible for managing material costs, maximizing profitability, and developing strategic supplier partnerships. Therefore, purchasing leaders should seek to formulate and implement strategies that leverage supplier partnerships to reduce the cost of materials, automate the purchasing process, and reduce the total cost of ownership of critical resources (Murfield & Tate, 2017). This study is significant to business practice because its findings could provide practical strategies for how businesses can gain

monetary value by managing material costs through supplier strategic relationships, cost avoidance, negotiations, or reducing design complexity.

Contribution to Positive Social Change

The implications for positive social change include the potential to develop sustainable supplier partnerships that affect the entire automotive ecosystem's learning and technical capacity. When businesses develop each other and continue to grow the automotive ecosystem's intellectual capital, they work together to improve the process and product performance. Supplier development strategies like technical investments or logistic integration improve local companies' economic and social performance (Yawar & Seuring, 2018). Local companies that hitherto lacked access to financial components or technological components may gain technical competence and business growth. Thus, the local companies can create more job opportunities for residents of the area and support local social programs.

A Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to explore strategies that some purchasing managers use to manage material costs. A literature review is a critical and essential requirement for a research study (Onwuegbuzie & Weinbaum, 2017). This literature review was intended to present a written approach to examining published information on RDT as the conceptual framework developed by Pfeffer and Salancik (1979). Additionally, the literature review includes other aspects of material cost management: supplier performance, supply chain price volatility, information technology (IT) impact in the supply chain, manufacturing cost management, outsourcing, additive

manufacturing, and reverse logistics.

In performing this literature review, I searched for peer-reviewed articles and scholarly books from Walden University's library database and Google Scholar. The databases that were used are as follows: (a) ABI/Inform Complete, (b) Business Source Complete, (c) Emerald Management Journals, (d) ProQuest Central, (e) Sage Premier, and (f) Science Direct. The keywords used to search for the literature included *material cost management*, *supply chain cost reduction*, *supply chain price volatility*, *purchasing strategies*, *information technology impact in purchasing*, *manufacturing cost strategies*, *lean management*, *recycling materials*, and *outsourcing*. The total literature reviewed was 100 references consisting of 95% peer-reviewed articles and 5% scholarly books. Over 90% of the sources used for this review were recent articles that were not more than 5 years old from this study's completion date of 2022. The sources were relevant in understanding previous work related to purchasing managers' strategies in managing material costs.

Resource Dependency Theory (RDT)

Organizations depend on one another for either raw materials, products, or services. The degree of organizational dependency will depend on the extent that the organization intends to either make or buy or outsource certain aspects of the manufacturing process (Caniëls & Roeleveld, 2009). The level of dependency an organization has on another organization can affect the production process or investment return (Caniëls & Roeleveld, 2009). Organizations need to consider whether the service is critical before deciding if they should outsource or not. Suppose the business leaders

decide that the service is critical; the outsourced service provider needs to be reliable and timely in service delivery. Foerstl et al. (2016) used RDT to generate evidence on how internal and external purchasing practices affect each other as well as the effect on operation, market, and business performance. Using the meta-analytic structural equation model (MASEM), Foerstl et al.'s findings indicated that organizations have imperfect forecasted data and visibility constraints about the value and access to strategic resources. Conversely, organizations' performance and competitive advantage are facilitated by both the organizations' tangible and intangible resources (Erevelles et al., 2016). These strategic resources are resources that are valuable, rare, and cannot be easily copied by another firm. A resource is *valuable* to an organization when the resource affects financial performance, and it is *rare* and *imperfectly imitable* when the resource is not abundant and cannot be easily copied (Turulja & Bajgoric, 2016). The combination of both the tangible and intangible resources of an organization creates an organization's competitive edge. Thus, organizations may have intangible resources that are unknown to them or known but cannot be easily harnessed.

Organizational resources are the resources that organizations use to gain a competitive advantage. Barney (1991) suggested that resources included physical capital resources, human capital resources, and supplier relationships. In the context of big data, physical capital resources comprise software or a platform that an organization employs to generate, store, and analyze big data (Erevelles et al., 2016). The fusion of business activities such as purchasing raw materials, human resources, marketing, and information technology to create rare and imitable products can create a competitive advantage. Most

organizations are likely to use market mechanisms in determining whether to conduct significant business activities internally or externally. In responding to Wernerfelt (2014) on whether a firm should focus on what it can do better than others, Ahlemann et al. (2020) suggested that a mature research stream makes it possible to rely on an established causal chain of value generation. Effective market research and the interaction between the various organizational resources contribute to creating business value. Therefore, from a resource dependency standpoint, the organization needs to research its capabilities before deciding whether to perform a task internally or externally.

RDT can also be applied in the financial market, for example, to understand if shareholders favor business analytic announcements or not. Teo et al. (2016) posited that business analytics announcements generate increased returns and provided empirical evidence to explain that organizations that implement business analytics systems obtain increased stock market returns compared to organizations that do not. In this instance, business analytic systems are a critical resource for organizations that are implementing them. However, Hsieh and Chou (2017) argued that gaining valuable resources is chiefly dependent on the quality of the resource inputs. Valuable resource inputs will allow organizations to gain market dominance over competitors and attain profitability. The interaction and collaboration between strategic resources and other organizational resources contribute to the resource-based discourse. Therefore, organizations need to develop strategies and capabilities to reduce the cost of owning such resources to realize higher returns.

Furthermore, RDT can also be applied in the healthcare industry. Wang and Hajli

(2017) used RDT to explore the three paths of value chains to reach big data analytics success. Big data analytics is widely considered as the next big thing in the innovation and management revolution (Aker et al., 2016). Big data involves the use of an efficient data management system to provide business insight to the firm (Lavallo et al., 2011). Business insights can help businesses with predictive analysis and business forecasting. Accessing information in real-time through the internet helps with both strategic and operational decisions. Wang and Hajli (2017) considered big data analytics as a significant resource that can be transformed into a sustainable competitive advantage. Firms that can use information and communication tools effectively in their business activities gain a competitive advantage. In today's competitive world, firms need to develop competitive strategies that will make them flexible and agile. Big data analytics also have tremendous benefits for healthcare firms, especially in improving the quality of care as well as improving financial performance. Although a firms' resources can gain a sustainable competitive advantage if they are valuable, rare, and inimitable, a firms' capability and capacity to deploy those resources is much more important than having the resources (Ahlemann et al., 2020). Healthcare business managers can use the information provided from big data analytics to quickly make decisions that can reverse an adverse trend in management.

Like the IT industry and healthcare industry, the automotive industry also faces the same multidimensional resource dependency challenges in supply chain management. With the growing need for companies to process big data and create visibility through the supply chain, technical methods like digitalization, blockchain, cloud computing, and the

internet of things, are becoming a necessary component of supply chain management (Zhang et al., 2019). Purchasing managers responsible for cost reduction use some of these technical methods to stem competition, economic uncertainties, market uncertainties, and supply uncertainties (Borodin et al., 2016). Mitigating uncertainties is essential for continued productivity and growth. Supply uncertainties, either due to a breakdown of IT infrastructure or hacking, can be very costly. As a result, multinationals reliant on emerging markets need to implement a robust IT infrastructure to improve communication and business operation and prevent supply disruptions. According to Kathuria et al. (2007), businesses develop strategies with internal resources and external resources to improve organization profitability. Purchasing strategies designed with the right tools and resources help coordinate, measure, and evaluate the effect on productivity. Mwangi and Kagiri (2016) added that the rapid changes of technology in the automotive industry call for purchasing managers to align technological changes with organizational strategies meticulously. While the use of technical methods may enhance the performance of supply chains, it may also expose the firm to various forms of cyber risk. Supply chains are vulnerable, and any uncertainty or disruption can be expensive.

Mobility and electric vehicles (EV) are disruptive technologies currently affecting the automotive industry. Many countries have recognized this opportunity as a viable replacement for oil dependency and preserving the environment (Kalaitzi et al., 2019). EV manufacturers face a deluge of supply chain issues ranging from lithium hydroxide scarcity to lack of rare earth materials. Kalaitzi et al. (2019) used RDT as the conceptual framework in a study to investigate the level of dependencies between firms during EV

production ramp-up. The application of RDT analyzed and explained the changing dependencies throughout the production ramp-up planning and execution phases. Kalaitzi et al. (2019) found that a more relational approach is necessary for intercompany relationships as production volumes increased. In addition to the supply of materials, key suppliers perform a supply chain's orchestrators role by offering direct guidance in designing and executing development plans.

The future success of supply chains will be based on supply chains that can automate and be nimble. Automating the supply chain and making it flexible and agile is a significant competitive advantage in many industries. Competition is no longer between firms but between entire supply chains (Madhani, 2016). Dells's distribution software development enabled them to move from local to global markets in many business areas (Szymanski & Prikladnicki, 2017). Similar to Dell's strategy is a supply chain automation strategy called a *one-touch supply chain* developed by Sun Microsystems in California (Burt et al., 2010). Sun microsystems changed a distribution system in which the supplier in Asia would ship server boards to an external manufacturing hub and then to a third-party integration box center, which sent the product to a distribution hub, then to a channel and reseller for shipment to the final consumer (Burt et al., 2010). In the new system, the server board goes directly from suppliers to the customer for standard products and to a geographic configuration center for custom orders (Burt et al., 2010). As a result of redesigning their supply chain, Sun has reduced logistics costs by 20 percent and finished goods inventory by 40 percent (Burt et al., 2010). On-time delivery and flexibility to customers changing needs will set the pace in future supply chains.

According to Tang and Tomlin (2009), flexibility enhances a firm's adaptability and agility. Automating the supply chain enhances speed and improves just-in-time delivery of raw materials. Early delivery of materials ensures that production downtime is minimized and customer order deadlines are met.

Another current trend that will affect supply chain management in the future is the digitization of the supply chain. With the growing need for companies to process big data and create visibility through the supply chain, technical methods like digitization, cloud computing, and the internet of things are becoming a necessary component of supply chain management (Zhang et al.,2019). Additionally, the application of artificial intelligence (AI) or multidimensional data sources to make rapid adaptive decisions aimed at identifying, assessing, mitigating, and monitoring unplanned events that may impact any part of the supply chain network (George et al., 2019). In the past two decades, recent occurrences or events such as: the adoption of lean management, just-in-time production, logistics philosophy, or natural disasters have increased the likelihood of supply chain uncertainty. If these risks identified can be mitigated by the adoption of AI techniques, then the threats of uncertainty or business continuity and reduced profitability can be controlled.

Evolution of RDT & Other Conceptual Models

Supply chains vary from one business to another. As a result, business leaders will adopt a supply chain theory that provides the right solution to their supply chain needs. Several theorists have developed global supply chain management theories, such as RDT. Pfeffer and Salanick (2003) started the concept of RDT in 1978 to explain how

organizational leaders can collaborate with their significant stakeholders or resources to gain business value (Pfeffer & Salanick, 2003). Earlier theorists such as Emerson (1962), Blau (1964), and Jacobs (1974) considered organizational behavior from an organizational context standpoint, but Pfeffer and Salanick added the influence of external factors to the organization. RDT deals with analyzing the power two parties have over one another and how far-reaching that power can affect their supply chains (Chicksand et al., 2012). The categorization of an organization as an open system subject to external environment contingencies led to RDT becoming one of the most influential theories in organizational and strategic management (Hillman et al., 2009). The power of influence that one organization wields over another is visible in proprietary designs and price changes. Pfeffer and Salanick recognized the influence of external factors on organizational behavior and suggested how business managers can reduce environmental uncertainties and dependence (Hillman et al., 2009). The five options proposed by Pfeffer and Salnick are: (a) mergers/vertical integration, (b) joint ventures and other inter-organizational relationships, (c) board of directors, (d) political action, and (e) executive action. If an organization has no means of creating a vertical integration or joint venture relationship, it may be challenging to control dependency. Dependency on critical resources without the adoption of one of the options proposed by Pfeffer and Salnick may be too risky. Therefore, understanding the various elements for mitigating risk due to resource dependency is essential to reduce supply uncertainties.

There are other theoretical perspectives besides RDT in the field of purchasing and supply chain management. Several theorists have developed different theories,

namely: institutional theory, systems theory, resource-based views (RBV), transaction cost economics (TCE), and principal agency theory (PAT) (Touboulic & Walker, 2015). In systems theory, the firm is viewed as an open system in which each system interacts and is continually influenced by the larger environment. Furthermore, systems theory is a body of literature that explores the dynamic relationship between humans, material objects, and technology in the generation of action (Booth et al., 2017). Von Bertalanffy introduced systems theory as a framework for understudying the interrelationship and interactions between diverse parts of the system and how each sub-system is independent of one another (Mania-Sanger, 2017). In an efficient global supply chain, strong interdependence is visible in the relationship between a raw material producer and a manufacturing firm. Performing internal transformations of inputs and producing outputs in a recursive feedback loop are the key elements of systems theory.

Another influential theory in supply chain management is the transaction cost of economics (TCE). TCE is an important theoretical perspective to an organization because it helps organizations in a make or buy decision-making and other management or governance decisions (Ketokivi & Mahoney, 2017). Although TCE started in the late 1960s and early 1970s, Ronald H. Coase was the first to highlight the importance of using TCE in 1937 (Ketokivi & Mahoney, 2017). TCE was developed based on organizational efficiency to address the primary supply chain question of how a complex transaction can be structured and governed to save cost and minimize waste (Ketokivi & Mahoney, 2017). Business leaders use TCE to analyze the total costs of a business decision recognizing uncertainties and other risk factors.

Similar to the RDT is RBV. RBV is a theory that incorporates traditional strategy insights concerning a firm's distinctive competencies and heterogeneous capabilities (Mahoney & Pandian, 1992). Business managers can utilize RBV as an organizational framework to determine what strategic resources they can exploit to achieve sustainable competitive advantage. Companies need to compete in the market for customers' attention and patronage, both locally and globally. RBV is a strategy whereby the company focuses on internal resources available to them to differentiate and gain a competitive advantage. The theoretical concept of RBV ensures that organizations can use their own valuable idiosyncratic resources for their benefit.

Supplier Performance

Businesses depend on suppliers for the supply and delivery of critical resources. However, some suppliers face difficulties arising from different factors such as raw material shortages, labor shortages, and capacity limitations. Jääskeläinen (2018) presented a paper in which he compared the characteristics of performance measurement in cross-functional and supplier-oriented purchasing and supply management practices. The study results highlighted the importance of measuring outputs instead of inputs and measuring supporting supplier relationship management, especially in the service context (Jääskeläinen, 2018). On the contrary, Zou et al. (2019) argued that service complexity, contract structure, contracting process, and follow-up management practices positively influence buyer-perceived supplier performance. Though earlier studies on performance management in service purchasing were not often explicit, both Jääskeläinen's (2018) and Zou et al. (2019) agreed that a broader overview of supplier performance measurement is

necessary for strategic purchasing. Business leaders need to develop a systematic method or metric for measuring the performance of suppliers. More especially, in a service-related contract where developing a scope of work can be daunting and complex. A method for determining the best suppliers in terms of prompt delivery and high quality is essential. Thus, designing an ongoing supplier performance contract that involves regular measurement of outputs from suppliers is necessary for measuring supplier performance.

Before global supply chain management, raw materials were sourced locally, but those efforts could not yield massive rewards (Yazdani et al. (2017)). As a result, organizations had to go outside their local areas to source materials to gain more significant rewards and maintain a competitive edge. The process of sourcing raw materials overseas is associated with different risks and uncertainties. Global supply management came to the fore to optimize and reduce risk in the supply networks through effective logistics, capacity, and supplier management. A successful supply chain requires coordination, collaboration, and coherence between different operations (Lambert & Cooper, 2000). Therefore, designing and tailoring the appropriate supply chain for lower cost and timely delivery is critical for the supply chain. Daneshvar et al. (2020) stated that manufacturing companies deal with various challenges, such as increasing uncertainty from both the demand side and the supply side of the supply chain. Bridging the gap between the supply side and the demand side will ensure that manufacturing companies remain profitable and grow their market share. On the contrary, when the supply side is affected by uncertainties, the organization cannot meet the needs of the demand side. Disruptions in the supply chain will occur in response to

increasing demand, evolving technology, and unpredictable events such as COVID-19 or natural disasters. Bidhandi & Valmohammadi (2017) added that uncertainties in markets' growth and uncertainties in dynamics of markets decrease product life cycles in the global environment. Therefore, supply chain leaders need to be proactive by improving flexibility, developing supply partnerships, eliminating the bullwhip effect, and planning long term. The organization's ability to quickly adapt and respond to environmental changes and market conditions will indicate a resilient and effective supply chain management system.

The key intent of measuring supplier performance is to manage supply risk and uncertainty. However, an efficient supplier performance management system often leads to improved quality and lower costs. While marketing and engineering impact sales by responding to the customer's voice, supply management impacts the bottom line by reducing costs. Mistry (2005) added that the supply chain's efficient management system reflects the intersection between financial and operations management to reduce or eliminate all non-value added costs. Similarly, Pavlis et al. (2018) demonstrated a model supporting supply management's contribution to financial ratios derived from balance sheets and income statements. The purpose of the study by Pavlis et al. (2018) was to explore the relationship between supply management performance and financial performance by evaluating the performance of supply management constructs and their impacts on the cash conversion cycle. In the quantitative study by Pavlis et al. (2018), supply management performance was analyzed using four dimensions, namely: (a) suppliers' quality, (b) suppliers' response flexibility, (c) information sharing with

suppliers, (d) price of buying materials. While the relationship between supply management performance and the cash conversion cycle was investigated using financial components, namely: (a) days of receivables, (b) days of inventory, (c) days of payables (Pavlis et al., 2018). The results of the study by Pavlis et al. (2018) indicated how supplier performance contributes to financial metrics such as return on investment (ROI). An efficient supply management system significantly affects the bottom line, and supplier performance is integral to an efficient supply management system. Therefore, managing supplier performance lays the foundation for, and is, key to successful supply chain management and profitability.

One of the metrics for measuring supplier performance is the timely delivery of orders or just-in-time delivery. However, the prompt delivery of orders is affected by manufacturing speed and the extent of design complexity. Favi et al. (2016) highlighted how different engineering design solutions could affect the ability to assemble and manufacture on time. Design solutions may be excellent from the assembly point of view but may not be cost-efficient or time-efficient in manufacturing. Complexities in the design affect operability, costs, and production time. In the study, Favi et al. (2016) developed a multi-objective design that is cost-driven to help engineers and designers in the selection of cost-effective design solutions. Designers may consider manufacturing time and costs while developing engineering design solutions.

In a related study, Singh and Singhal (2020) explained that modern manufacturing involved controlling manufacturing costs by reducing the cycle time or applying tactics such as clustering or sequenced tooling. The process of clustering in the production

process consists of using a single setup to execute a group of production operations (Singh & Singhal, 2020). At the same time, sequenced tooling refers to the ability to do more operations using the same workpiece or cutting tool (Singh & Singhal, 2020). A company can succeed if it meets the customers' delivery schedules by reducing waste, product variances, and production time. As businesses challenge suppliers to generate cost savings without losing performance on quality and logistics every year, the supplier needs to develop new methods. Some of the methods may include reducing design complexities and cycle time, clustering, and sequenced tooling.

Supply Chain Price Volatility

Commodity price volatility is a major concern for management in making supply management decisions (Gaudenzi et al., 2020). Unfavorable commodity price risk volatility (CPV) can cause detrimental financial effects on the firm (Gaudenzi et al., 2020). For instance, persistent changes in construction materials prices can affect the project's outturn costs (Oluwole et al., 2018). The project outturn cost is determined by all the factors affecting the construction project's actual cost. In construction or project management, costs are usually estimated in phases or per milestone. Therefore, actual project costs or outturn costs will likely remain unknown until project completion (Oluwole et al., 2018). In another study, Gaudenzi et al. (2020) suggested two complementary methodologies for managing the financial effects of price volatility, namely, total cost of ownership (TCO) and real options valuation (ROV). The TCO and ROV methodologies illustrate how commodity price risk mitigation strategies can be analyzed based on their effect on costs and performance. Using TCO and ROV

techniques provided a cost-based analysis of the commodity purchasing process and set priorities regarding cost-saving opportunities and excellent data for negotiations with suppliers. A practical cost-based analysis can reduce commodity price volatility. Business leaders that can calculate the TCO or ROV of their raw material purchase can quickly identify potential risk in commodity price volatility. Therefore, identifying, understanding, and mitigating potential price risk volatility by creating a flexible and visible cost-based supply network is essential.

Building strategic supplier partnerships with innovative suppliers can help mitigate price volatility and inconsistency. Product innovation is necessary for success in many industrial sectors. Notably, automotive suppliers are a critical source of innovation for major vehicle manufacturers in the automotive industry. As cars become more sophisticated and complex, the specialization of suppliers on specific product categories is essential. Hence, posing a challenge to automotive companies' purchasing department in following innovative trends in the industry. Sourcing and purchasing professionals use various data sources, knowledge, and information to help with sourcing strategies. One of the data sources is the extraction of patent data through patent analysis (Trautrim et al., 2017). Patent analysis has been used in the past to identify partners for acquisition or collaboration at the same supply chain level. However, patent analysis has not been a significant source for supporting strategic sourcing or as a management resource for supplier selection processes (Trautrim et al., 2017). Selecting a supplier is a multi-dimensional decision that needs to consider, amongst all others, the ability to create value, innovation capabilities, and price stability. In a highly competitive industry, the

competitive advantage will depend on the purchasing department's ability to identify and select innovative suppliers. Many businesses drive product innovation through marketing and engineering, but the procurement group can also drive innovation (Walker & Penfield, 2015). To illustrate the effect of the procurement group in innovation, Trautrim et al. (2017) collected data from the US patent office to analyze product innovation supply categories. The two categories analyzed were the car body technologies and the car seat categories of a leading premium automotive manufacturer. The study's outcome indicated that patent analysis provides a quantitative indicator to identify innovative suppliers and support supplier selection decisions. Analyzing patents gives purchasing managers access to innovation potentials and developments in various sourcing categories. The process of analyzing patent data is a targeted approach for the procurement group to identify innovative suppliers. Business leaders can select from the pool of innovative suppliers to form long-term mutually beneficial partnerships.

Information Technology (IT) Impact on Supply Chain

Shortages can occur due to natural disasters or uncertainties. Recent occurrences like COVID-19 or the 2011 Thailand floods can cause shortages in critical raw materials (Thantanajit, 2020). For example, the microcomputer chips shortage arising from the current pandemic has increased product prices due to plant shutdowns. The shortage of microcomputers chips has further led to increases in the price of automobiles, computers, and electronics. Some corporate policies, such as: (a) increasing globalization, (b) lean management, (c) just-in-time production, and (d) less vertically integrated supply chains, have exacerbated supply chain complexities and uncertainties (George et al., 2019). In

conducting a qualitative study, George et al. (2019) explored the adoption of artificial intelligence (AI) in decision making, predicting, learning, and developing a strategy to deal with uncertainties. George et al. (2019) stated that the use of multidimensional data sources could help business leaders make rapid adaptive decisions. AI technology could be instrumental in identifying, assessing, mitigating, and monitoring unplanned events that may impact any part of the supply chain. Although George et al.'s study was limited in the practicality of AI and the extent to which it could apply to the supply chain, AI is effective in simplifying a complex process. Li et al. (2017) suggested that the usefulness in the use of AI is visible in intelligent manufacturing systems. Intelligent manufacturing is the new gold standard for production (Li et al., 2017). Therefore, the synergy between manufacturing systems and information communication technology will lead to smart, intelligent manufacturing systems that will produce faster, cleaner, and higher precision products. The addition of AI to the manufacturing process will ensure that machines are performing optimally. Rather than machines failing abruptly, they could send signals through AI technology to inform business leaders of a potential failure. The constant flow of data from the machines could lead to a learned pattern that business leaders can utilize to guarantee operability.

The utilization of AI alone is not enough in smart manufacturing. For smart manufacturing to be conclusive, the fusion of autonomous intelligent sensing, collaboration, cognition, decision making, control, and human involvement is necessary for the product life cycle (Li et al., 2017). Gunesekaran et al. (2017) opined that supply chains need to utilize IT strategically to gain a competitive advantage. If a firm uses IT

strategically and synergistically, it will help them achieve alignment, adaptability, and agility. Conversely, firms that fail to develop the appropriate IT capability may still gain a competitive advantage, but it will not be sustainable (Gunesekaran et al., 2017). Firms that want to develop a sustainable competitive advantage will need to have a unique IT capability. Therefore, developing the right IT capability that uniquely differentiates the firm may help create a sustainable competitive advantage.

IT plays an essential role in integrating and enhancing information flow within the supply chain. Firms create an information exchange network to ensure a smooth flow of information throughout the extended supply chain. Strategic supply chain relationships are necessary to share, collaborate, and make collective decisions across the supply chain network (Singh & Teng, 2016). However, information exchange does not guarantee improved performance by itself but can be beneficial when combined with other integration tactics (Vanpoucke et al., 2017). Integrating supply chain tactics alone may not be sufficient without investigating their corresponding operational performance impact. Vanpoucke et al. (2017) pointed out how operational performance is affected by the integration and interrelationship among integration tactics. IT is effective in the integration aspect, and it allows supply partners to increase data exchange volume and complexity. The exchange of data is necessary for information flow within the supply chain and improves supplier relationships. Thus, IT integration is not inert, but rather it is integral in enhancing supply chain performance.

Businesses competing for market share also utilize IT to gain a competitive advantage. Gaining a competitive advantage is essential to business success. Many

companies may strategically decide which approach to take on, whether a low-cost strategy or a product differentiation strategy (Abdelkader & Abed, 2016). If the firm's approach is to be a low-cost provider, they need to perform business activities at a lower cost than competitors. Conversely, if the firm's business strategy is product differentiation, they need to conduct business activities that lead to innovative products and a premium price. Nowadays, companies can no longer gain a competitive advantage strictly by product differentiation or low-cost technique, but now have to be more creative (Abdelkader & Abed, 2016). Porter (1985) explained that when a firm can create value for customers that far exceeds the cost in creating it, they gain a competitive advantage. The utilization of IT capability as a strategic competitive weapon may be that new differentiation tool that companies need to gain an advantage (Bobb & Harris, 2011). Although IT capability is widely accepted to create a competitive advantage, not all technological changes enhance competitive advantage. According to Porter (1985), some technological changes might worsen a firm's competitive advantage and industry attractiveness. Turulja and Bajgaric (2016) added that extensive research is still needed to confirm the positive relationship between IT capability and business performance. Nevertheless, if there is no positive correlation between IT capability and business success, why do firms invest significant IT infrastructure capital? More so, today's IT infrastructure often consists of standard solutions easily imitable (Zardini et al., 2016). The IT solution may initially be unique, but other firms can learn and implement similar or better technology. If a company can easily acquire or outsource IT infrastructure as any other company, how does it still create a competitive advantage?

Competitive advantage is formed by the fusion of business activities such as purchasing raw materials, human resources, marketing, and information technology to create rare and not easily imitable products. As long as the IT infrastructure is not easily imitable, it may create a competitive advantage. IT can aid these business activities and connect global supply chains to enhance competitive advantage. Business activities are actions related to creating a product or service, including marketing, delivery, and aftersale support services (Porter & Millar, 1985). Competitive advantage is gained when information technology has a powerful effect on either cost or differentiation (Porter & Millar, 1985). With a superior information technology infrastructure, firms can dominate an industry and set high barriers to entry. However, opportunities for gaining competitiveness will be available indefinitely. Firms that once gained a competitive advantage through IT capability can lose it due to replicability. IT's potential to differentiate one firm from the pack declines as it becomes replicable or more accessible (Carr, 2003). The risk of replicability subjects investments in IT to rapid price deflation. Given that to gain a competitive advantage in a constantly changing market, IT capabilities are required to adjust, integrate, reconfigure, and recreate internal and external competencies. IT capability can mainly help a business that already has unique business activities that produce exceptional products.

Complex bundles of IT tools characterize today's business processes. IT skills and knowledge are necessary to enable firms to coordinate business activities and utilize IT assets to provide the desired results (Neirotti & Raguseo, 2017). Current advanced and emerging digital technologies include the Internet of Things (IoT), blockchain

technology, cloud computing, big data analytics, and e-Procurement systems. Zhang et al. (2019) described the digital supply chain as any instance in which information technology implementations and the traditional supply chain intersect. According to Zhang et al. (2019), the four requirements of the digital supply chain include: (a) controlling the cost of the process, (b) traceability throughout the entire supply chain, (c) transparency throughout the supply chain, and (d) accountability within the supply chain actors. Though the digital supply chain may adequately improve visibility and traceability within the supply chain, it is still an emerging tool with challenges that raises concerns as the industry grows. For instance, cybersecurity concerns that can occur via software or hardware attacks must be addressed as the technology's adoption grows. Similarly, trust issues have not been adequately addressed, nor are there universally accepted models to manage them.

Businesses require data to make decisions and managing extensive data can be burdensome. Various emerging IT tools, such as cloud computing and big data analytics, are useful in studying customer trends and operations, sales, and revenue performance (Alamoudi & Alamoudi, 2016). Business leaders can use the information provided by big data analytics to make strategic decisions that can reverse an adverse trend in management. The ability to use big data shortens the time required to make decisions and increases speed to market, thus, enabling competitive advantage. Furthermore, access to information in real-time through the internet helps with strategic and operational decisions. Alamoudi and Alamoudi (2016) described cloud computing as a system for storing and accessing data, programs, and applications over the internet. Firms that can

use information and communication tools effectively in their business activities gain a competitive advantage. In today's competitive world, firms need to develop competitive strategies that will make them flexible and agile. Karagoz et al. (2015) added that for logistics firms, assessing the right information at the right time, at the right conditions, and in the right place increases its efficiency and performance levels. Additionally, Bach et al. (2016) pointed out that the best strategic decisions are made when the right persons are provided with complete, correct, relevant, and timely information. Without accurate and timely information, business managers would make uninformed decisions that may lead to losses. Cloud computing allows for the delivery of on-demand computing resources ranging from the application to data centers and over the internet pay-as-you-go service (Alamoudi & Alamoudi, 2016). Information is the live wire for strategic decision-making, and the prompt delivery of information can make a big difference in how businesses can position themselves for competitive advantage.

Additionally, the application of information technology improves both a payment system and a communication system between stakeholders. IT-enabled e-Procurement system enhances purchasing activities to provide a more efficient and cost-effective process for a business to reduce transaction costs, make better decisions, minimize order cycles, and improve supplier and customer relationships (Pongsuwan, 2016). Today's technology provides a new channel for procurement activities to manage transactions and processes effectively (Pongsuwan, 2016). IT has transformed procurement from a paper-based process to online bidding, ordering, payment, goods dispatch notices, and logistics and supply chain management system. According to Carr (2003), IT is like a transport

mechanism that carries digital information the same way railroads carry goods and power grids carry electricity. The effective use of IT can reduce procurement costs in any part of the value chain and aid speed to market. Thus, competitive advantage is gained when IT has a powerful effect on either procurement cost or differentiation. Firms will, therefore, need to decide what IT theory or IT theories to adopt that will provide the right solution to their needs.

Several theorists have developed IT theories for competitive advantages, such as resource-based view theory, socio-materialism theory, and resource dependence theory. Barney (1991) introduced the RBV, and it is based on the notion that firms are fundamentally heterogeneous in terms of their resources and internal capabilities (Peteraf, 1993). RBV is an organizational framework that business managers can utilize to determine what strategic resources they can exploit to achieve sustainable competitive advantage. The theory incorporates traditional strategy insights concerning a firm's distinctive competencies and heterogeneous capabilities (Mahoney & Pandian, 1992). Organizational leaders compete in the market for customers' attention and patronage and RBV is a strategy whereby business leaders focus on using available internal resources to differentiate and gain a competitive advantage. A resource is valuable to an organization when the resource affects financial performance (Turulja & Bajgaric, 2016). Firms endowed with such resources can produce more products economically, maintain market dominance, and better satisfy customers. Thus, a firm that controls its resources can build and sustain market dominance and gain a competitive advantage.

Based on the resource-based theory, big data analytical capability could be the technical capability of a firm that makes it distinct from others. However, RBV relies on two core assumptions about firm-based resources that show why some firms perform better than others (Aker et al., 2016). First, some firms perform better than others because they possess certain capabilities or technologies that others do not possess. As firms continue to operate in the same industry, they develop different skills set and resources that make the most suitable for performing specific functions with the help of their unique skills. Second, the heterogeneity in resources is enhanced by the difficulty of exchanging resources across firms (Aker et al., 2016). Business managers may find it challenging to integrate the different firm-based resources. Therefore, resource immobility is indicative of the synergistic benefits of various resources that are sustained over time.

Conversely, the socio-materialism theory is based on the intersection of technology, work, and organization. Socio-materialism theory emphasizes the relationships between human actions and material arrangements and how these relationships emerge in practice (Nyström et al., 2016). Based on the socio-materialism theory, big data stems from a delicate mixture of management, human talent, and technology (Aker et al., 2016). In organizational research, social and material perspectives are inseparable. Therefore, socio-materialism theory presents a balanced view by interlinking management, technology, and human dimensions.

The idea of RDT stems from the fact that firms cannot produce all the resources they need to sustain themselves. Hence, firms need to develop relationships with other

firms with capacity in specific areas of interest. Pfeffer and Salancik (2003) developed the theory and used it to explain how organizational leaders can collaborate with their significant stakeholders or resources like IT companies to improve profitability (Pfeffer & Salancik, 2003). RDT was underpinned by the idea that resources are essential to organizational development and that access and control over resources form the basis of power (Pfeffer & Salancik, 2003). In the pursuit of resources, organizations need to identify and develop effective, dependable, and sustainable partnerships. Wolf (2014) suggested that collaboration between the firm and partners increases both the partner's as well as the firm's performance and business value. Company profitability will depend on its ability to cooperate with partners, acquire required resources, and integrate the resources into its systems and operations (Zou et al., 2019). In technology adoption, the affiliate obtains and utilizes technologies transferred from other multinational enterprises to exploit existing technology-based competitive advantages (Liu et al., 2017). Small businesses saddled with the challenge of entering new markets, creating new products or services, developing excellent relationships with suppliers and customers, and developing efficient manufacturing, marketing, sales, and support can leverage IT resources that other companies developed. For example, cloud technology allows small businesses to scale their business without large investments in servers, software, hardware, applications, and expensive IT equipment (Alamoudi & Alamoudi, 2016). Companies can use IoT to collect data about how their products perform and use big data analytics to understand and predict future consumer behavior. In the manufacturing industry, the voice of the customer is necessary for new product design and production. The

automotive industry has been faced with refining and upgrading its technological features (Coppola & Morisio, 2016). As a result, more sophisticated functions have been provided, and these technologies have laid the foundation for the concept of intelligent transportation systems (Coppola & Morisio, 2016). A connected vehicle refers to a car that can communicate with other vehicles or smart devices and collect real-time data from multiple sources through the internet (Coppola & Morisio, 2016). Modern cars equipped with several IT connections have created more sales for the manufacturer and created a competitive advantage. As more vehicles join vehicular networks, automotive leaders will develop more applications to communicate with big data. A connected communication exchange will predict better routes, report traffic incidents, reduce road congestion, and recommend car maintenance or repair (Uden & He, 2017). IT plays an equally vital role in identifying how customers want to be served and their purchasing preferences in the services industry. Fu (2020) presented a study that assessed blockchain technology utilization in storing and recording library collections. In the study, Fu (2020) added that IoT, finger-vein biometrics, image recognition, and wireless sensors technologies were used to control access into the libraries. Gunasekaran et al. (2017) added that for supply chains to achieve competitive advantage through IT capability, the organization needs to utilize IT strategically. Similarly, IT has revolutionized the traditional way of logistics and supply management. Some of the benefits that have been achieved in supply chains because of IT capability include increased efficiency and responsiveness (Gunasekaran et al., 2017). Logistics management is one of the contributing operations that encompasses activities ranging from customer service, order

processing, inventory management, transportation, distribution, and warehouse management (Karagoz & Akgum, 2015). All of these operations are supported by enormous information flows, and IT capabilities help develop unimitable capabilities that make a difference in firm performance (Karagoz & Akgum, 2015). If the firm applies IT as a critical strategic function, it will help them achieve alignment, adaptability, and agility.

Manufacturing Cost Management

Automotive suppliers bid for orders based on the production process cost estimates. The manufacturing process is made up of several cost centers and operations linked by intra-plant logistics. In determining how organizations can generate accurate cost estimates, business leaders may use both decentralized and centralized approaches to cost estimation (Andrea et al., 2020). In a recent quantitative study, Andrea et al. (2020) found links between decision-making at different cost centers, highlighting the importance of coordinating the cost estimation process. After that, a stochastic model was applied to analyze the uncertainties during the bid process like demand, capacity consumption, and cost. Andrea et al. (2020) suggested that the quality of the estimation process would depend on the complicated relationship between the different cost centers. In another study, Palmer et al. (2018) presented a report on assessing the total cost of ownership of conventional, hybrid, plug-in hybrid, and battery electric vehicles. Hybrid electric vehicles have a high price premium compared to conventional cars. In assessing the total cost of ownership, Palmer et al. (2018) combined the purchase price and operating expenses to identify the vehicle's most economical choice. Calculating the total

cost of ownership can be applied in either a *make or buy decision* or to determine the total cost of ownership of one material over another. Similarly, the total cost obtained by the simultaneous, decentralized decision-making approach may be lower than the sequential, decentralized decision-making approach. Therefore, to generate accurate cost estimates, business managers need to consider both the total cost of ownership and the quality of the estimation process.

The concept of the total cost of ownership in purchasing involves the material acquisition cost and cannibalization cost or sunk cost related to acquiring the material. In a related decision-making study, Creti et al. (2018) used a partial equilibrium model to determine the optimal phasing out of polluting goods for green goods. The case of hydrogen or fuel cell electric vehicles for gasoline vehicles' substitution provided an excellent illustration for the methodology. In the study, Creti et al. (2018) estimated that hydrogen vehicle technology would replace internal combustion engines by 2050 if there is no significant breakthrough in battery technology. For hydrogen vehicle manufacturing firms to fast-track the technology, they need to adopt a learning-by-doing concept (Creti et al., 2018). Learning-by-doing impacts the deployment of the technology and could lead to more production and higher expenses today for lower unit costs and lower expenses in the future (Creti et al., 2018). The learning-by-doing and the production of hydrogen vehicles implied that manufacturing costs would reduce, and the total cost of ownership of both technologies will converge in 2050 (Creti et al., 2018). Furthermore, Creti et al. (2018) calculated the decarbonization effects arising from the technological change using the marginal abatement costs (MAC). MACs are practical indicators for measuring the

marginal cost incurred for avoiding one unit of carbon emission by replacing dirty technology with clean technology.

In quantitative research, Kavlak et al. (2018) advanced a conceptual framework for quantifying the causes of cost changes in technology. Kavlak et al.'s study was applied to photovoltaic (PV) modules to identify why their costs have declined in the past and gain insight into maintaining the trend in the future. The research started with a cost model that fragmented the cost elements into variables that changed over time. Kavlak et al. (2018) observed the changes in the cost model's variables and captured them under two headings: low-level causes and high-level causes. Low-level mechanisms referred to cost reductions that occurred due to technological cost implications. In contrast, high-level mechanisms referred to cost associated with R&D, scale economies, and learning-by-doing. Kavlak et al. (2018) asserted that key drivers of decreasing costs have been changing over the periods investigated. However, the economics of scale have had the most impact and can continue to offer further PV cost reductions in the future. Economies of scale may be exhausted over time because there is a limit to how much plant sizes can expand to meet the scale required. Overall, Kavlak et al. (2018) pointed out that market-stimulating policies have affected PV modules' cost with economies of scale, R&D, and learning-by-doing, contributing about 60% to the cost reduction in PV modules. These studies in hydrogen technology and PV modules support the idea that learning by doing in cost management is economically viable with future environmentally sustainable benefits. Additionally, the cost of phasing out one technology for another is part of the total cost of ownership.

Today, reducing carbon emissions and climate change is an ongoing conversation at both government and automotive industry leadership levels. Remanufactured components can reduce production and energy costs by 80% and lower CO2 emissions (Muftooh et al., 2019). To show how remanufacturing can reduce manufacturing costs, Muftooh et al. (2019) investigated the feasibility of using a visual structure for motion (VSFM) in developing a 3D digital model for automotive engine automation. VSFM is a low-cost method involving industrial robots to assess the engine's pre-disassembly 3D model using the videogrammetry capability. Videogrammetry is a video-based photogrammetry process used to capture data (Muftooh et al., 2019). This digital model of assessing components is required to automate the disassembly process, improve cyber-physical systems, and align with industry 4.0 requirements. Opting for a low carbon strategy may reduce manufacturing costs, pollution, greenhouse gas emissions, energy consumption and help the rising threat of climate change. The process of remanufacturing or re-purposing machines helps with reducing landfills and cost avoidance. Businesses that could have made a capital investment in a new machine would avoid that cost. Likewise, waste that would have been generated from discarding the old machine would be avoided.

Remanufacturing is an effective way to make progress towards sustainable and cleaner production because the process encourages the re-use of materials and reduces waste. Machines that could have been replaced by buying new machines can be revitalized for less cost and reused in business operations. These improvements can contribute to greener production, especially for the remanufacturing of automobile

engines. Managers in the remanufacturing space have been faced with inaccuracies in scheduling and inconsistencies in remanufacturing resources information. Zhang et al. (2018) applied the internet of things concept to form an internet of manufacturing things environment in the remanufacturing of automobile engines. In the study, Zhang et al. (2018) designed an identification technology for disassembled engine parts and monitored the remanufacture resources' real-time status. Zhang et al. (2018) developed a real-time production scheduling method and developed a mathematical model to reduce costs, energy consumption, and dynamic management of remanufacturing resources. Dhiravidamani et al. (2018) performed a study on another manufacturing process to reduce waste, referred to as lean manufacturing. Lean manufacturing is an operational system applied in the value stream to maximize value and reduce or eliminate waste in all processes (Dhiravidamani et al., 2018). Implementing lean manufacturing techniques reduces processing time, set-up time, non-value-added time, and core rejections. In contrast, Kaizen concepts are used to identify improvements that business managers can implement without additional expenses and changes in design (Dhiravidamani et al., 2018). Kaizen is recognized in the global manufacturing space as a method of continuous improvement and improved efficiencies. Thus, the implementation of remanufacturing, lean manufacturing, and Kaizen concepts could improve manufacturing process flows and costs. Business managers that engage in a combination of remanufacturing, lean manufacturing, and Kaizen concepts will ultimately reduce the cost of production and improve the production process.

Additive Manufacturing

Additive manufacturing is often used interchangeably with three-dimensional (3D) printing to describe the same approach of fabricating parts. Additive manufacturing involves the process of joining materials to make objects from 3D models. Unlike a subtractive method whereby a product or part is made by cutting away sections or injecting material into the mold to create the desired part, additive manufacturing involves adding material layer by layer (Thomas, 2016). Current studies on additive manufacturing have been limited in scope due to the complexities of measuring additive manufacturing costs and data limitations. In additive manufacturing, there are three primary aspects associated with economics: measuring the value of goods produced, measuring the costs and benefits of using the technology, and estimating the adoption and diffusion of the technology (Thomas, 2016). Thomas (2016) further proposed examining and understanding the societal costs and the benefits of using this technology from a monetary standpoint and a resource consumption perspective. This technology helps in effectively producing prototypes, components, and parts using various materials, including metals, glass, and plastics. Specifically, additive technology can help make automobiles lighter in the automobile industry to reduce fuel costs, or combustion engines might be re-designed to reduce cooling needs.

Additive manufacturing can be applied in fields other than the automotive field. For example, an application of additive manufacturing was illustrated in a qualitative study by Muhammad et al. (2019). The purpose of the study was to investigate the feasibility of producing high-precision metal components using a fine wire-based laser

metal disposition (FW-LMD) process. The FW-LMD process uses a fine stainless steel wire as the additive material and a pulsed Nd: YAG laser as the heat source. Muhammad et al. (2019) found that the additive process showed feasibility for fabricating high-resolution metal components and rapid prototyping applications. It is a possible solution for improving surface finish and can be an attractive alternative for 3D printing of high-precision metal components. Business managers in either the medical or automotive industry can apply this process for rapid prototyping. The process of rapid prototyping is a technique that helps business leaders quickly fabricate a part or assembly using computer-aided 3D designs. Innovative companies can quickly try out their designs without making huge investments in labor time and capital.

Additionally, the concept of additive manufacturing improves social and environmental sustainability. Matos et al. (2019) conducted a study that explored the implication of additive manufacturing technology to social, health, wealth, and quality of life. The research design was an exploratory multiple case study conducted among four Portuguese organizations that apply additive manufacturing. In collecting interview data from the participants, the study was guided by three research questions: (1) What are the causes of additive manufacturing impacts? (2) What types of social impacts are expected? (3) Do they have a positive or negative effect(s)? The main objective of the interview questions was to elicit opinions and experiences from the interviewees. Matos et al. (2019) found that health, safety, and wealth are positively affected by additive manufacturing. Similarly, in the case study presented by Mohajeri et al. (2020) to explore the effects of shifting from conventional screen-printing to digital textile printing, they

found that brand owners are responsible for directing the implementation of sustainability programs in the textile industry. The purpose of the study was to assess the contribution of social manufacturing to sustainability. Social manufacturing is a new phenomenon in sustainability.

Drawing from the principle of social manufacturing, Mohajeri et al. (2020) designed a collaborative business model to improve sustainability initiatives in the apparel industry value chain. The idea was that a collaborative model could help speed up the desired shift from conventional screen printing to digital textile printing. Digital printing is seen as a versatile technology for textile modification and can add antimicrobial and bacteriostatic properties to the textile. Therefore, Mohajeri et al. (2020) suggested that the collaborative model empowered by social manufacturing by the brand owners can help develop and implement digital printing in the apparel industry. Additive manufacturing offers a clean manufacturing approach that is helpful to the environment and society. The application of additive manufacturing is both a cost reduction strategy as well as an environmentally sustainable initiative through social manufacturing.

Outsourcing

Outsourcing is a popular term for non-ownership or contracting out an entity's internal business processes to an external supplier or provider. As organizations seek more innovative ways to create value and improve their operations and capabilities, outsourcing has become a strategic initiative for the purchasing group. Organizations tend to outsource functions that are not central or a core function of the organization, such as; payroll, cleaning, training, maintenance, data processing, information technology,

logistics, and internal audit. Mirghani (2018) found that some roles are given to accounting and finance staff in some outsourcing projects. However, these roles range from the financial evaluation of new outsourcing proposals and alternatives, consultation and price negotiations in the planning and feasibility stages of outsourcing relationships. The management of outsourced functions involved informal control mechanisms such as trust, knowledge sharing, mutual understanding, and cooperation between partners (Mirghani, 2018). In a related study, Ahmed (2019) sought to investigate the use of performance measurement and risk-reward incentive as a governance control mechanism. Results of the findings indicated that financial incentive schemes were designed to motivate the outsourced firm to achieve more financial cost savings and other qualitative benefits to the outsourcing company. Managing the outsourced function involves routine budgetary control systems and informal control mechanisms such as trust, knowledge sharing, mutual understanding, and cooperation between two collaborative partners. Organizations outsource certain functions to generate cost savings, free up internal resources, and improve service or quality by gaining access to more specialized skills or world-class capabilities. However, managing the performance and risk associated with outsourcing may be challenging for these organizations

Though outsourcing is beneficial to the firm, it can also cause unexpected threats in either price increases or supply disruptions. Risks that can arise may be due to raw material shortages, affecting one or more suppliers in the value chain. Raw material shortages may also result in price increases and the non-availability of purchased materials and supplies, leading to the production plant's downtime. As a result, firms take

proactive steps to monitor and manage changes in the supply chain to reduce the effects of disruptions. Researchers working in supply chain management use a diverse range of theories to understand various supply chain needs and minimize risk.

Reverse Logistics

Reverse logistics is encouraged by most governments in the world because of environmental sustainability concerns. Logistics plays a strategic role in a firm's success, and it is one of the critical elements of supply chain management (Marchesini & Alcantara, 2015). The increasing demand for automobiles has led to increasing waste from an inadequate scrap management system. For instance, Chinese leaders established an auto scrapping standard that phases out automobiles after 15 years of service life (Zhikang, 2017). However, as a major consumer of steel, iron ore, and coal, most automotive companies have not created an efficient reverse logistics process that saves cost, time, and the environment. Scrap materials are generated during the production process, as well as product recalls. The number of waste cars in China is very large, and an effective reverse logistics framework will reduce production costs and show significant cost savings.

Maintaining an efficient supply chain network involves effective recycling and reverse logistics systems. The supply chain network should be of the highest quality and be cost-effective at the same time (Khan & Sawicka, 2016). Unfortunately, most automotive companies do not pay attention or fully understand the benefits of reverse logistics (Zhikang, 2017). Automotive companies have not prioritized reverse logistics as a core business strategy but rather focus more on product research, product development,

and sales. The perception of manufacturing firms is that reverse logistics or product recycling is not a competitive advantage, and it will cause damage to the company's reputation and image. Manufacturing firms fail to understand that competition is no longer between firms but between entire supply chains (Madhani, 2016). Rogetzer et al. (2018) conducted a quantitative study to investigate the use of recycled materials as a sustainable sourcing strategy in manufacturing. Manufacturing companies' source different materials in short supply, like rare earth elements for electronic products. For example, strategic raw materials can either be sourced from a virgin material supplier or a recycler in producing an electronic product.

Recycling is an additional sourcing option that can integrate raw materials out of steadily increasing waste streams back into the production process. In performing the study, Rogetzer et al. (2018) developed a single-period inventory model to calculate the difference in order quantity and costs between virgin and recycled materials. After that, the authors conducted a full factorial design and detailed numerical sensitivity to evaluate the cost savings potential. The numerical analysis helped the authors gain insights into the benefits of green sourcing, including recycled materials compared to standard sourcing. Specifically, the numerical analysis helped the authors understand how demand, recycling quantity, and recycling price uncertainty impact expected costs. Based on the numerical results, Rogetzer et al. (2018) found that in terms of cost savings, the green sourcing approach, including recycled materials, is most beneficial compared to the standard sourcing case without recycling materials. Additionally, sourcing with recycling in mind is not only economically viable but also improves the environment.

To have an efficient supply chain network and reduce the cost of materials, automotive firms need to institute reverse logistics as an integral part of the supply chain network. Choosing a modular engineering design supplier over an integrated engineering design supplier will ensure that generated scrap is reduced substantially (Andinliyim & Murthy, 2016). A modular design supplier that is strategically located to the source of raw material and supports cut-to-fit modularity should be a preferred supplier to the automotive firms. This policy will place the responsibility for end-of-life management in the hands of suppliers and forces them to internalize these costs (Gaustad et al., 2018). These policies are like the take-back programs of retailers or collection sites. For example, www.bestbuy.com, a major retailer in the US, accepts dozens of electronic products and recycles them for free or a small fee of \$25. Also, www.firstsolar.com, a solar manufacturer, offers collection services from the installation site to retain high-value semiconductor material containing scarce tellurium (Gaustad et al., 2018). A well-crafted reverse logistics plan can reduce the number of raw materials, steel, non-ferrous materials, and components used in the production of automobiles.

Transition

Section 1 included the foundation of the study, the background of the problem, problem statement, purpose statement, nature of the study, research question, interview questions, conceptual frameworks, operational definitions, assumptions, limitations, delimitations, and significance of the study. The significance of the study segment consisted of the contribution to effective practice of business and the contribution to

positive social change. Finally, I performed an analysis and synthesis of a review of the professional and academic literature related to my proposed study.

In Section 2, I discuss the purpose statement, the role of the researcher, participants, research method and design, population and sampling, ethical research, data collection instruments, data collection technique, data organization technique, data analysis, reliability, and validity. In the final section of this study, Section 3, I present detailed findings, including the applications to professional practice, implications to social change, recommendations for actions, recommendations for further research, my reflections, and conclusions.

Section 2: The Project

In this section, I restate the purpose statement, explain the role of the researcher, and indicate the participants for my study. Furthermore, I justify my choice of research method and design, population and sampling, and ethical concerns for this study. Lastly, I explain the data collection instruments, data techniques, data organization, and data analysis framework, followed by the reliability, validity, and transition and summary subsections.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies purchasing managers use for managing material costs. The targeted population consisted of purchasing managers from four different automotive companies in Detroit, Michigan, who have successfully implemented material cost strategies. The implications for positive social change include developing sustainable partnerships with local companies that may help create jobs for residents of the area and support local social programs.

Role of the Researcher

My role in this qualitative study was to solicit, compile, organize, and analyze data related to purchasing managers' strategies for managing material costs. After a detailed analysis and triangulation of the data, I interpreted and reported the findings from the study. The qualitative methodology involves complex situations and results in valuable findings, but also, the researcher plays a huge role in shaping, aligning, and interpreting the research findings (Pathirana et al., 2020; Sutrisna, 2009; Yin, 2018). Research findings that are free from bias could be valid and reliable in the field of

research. Additionally, business managers in the field of purchasing or supply chain management could apply the outcomes of the study to improve business outcomes.

Though my background is in purchasing and supply chain management, I interviewed purchasing managers responsible for formulating and implementing purchasing strategies. Knowledge in a field of study is helpful to researchers to understand participant's insights and perspectives (Sacks, 2018). However, I approached this study without bias because I had never formulated or implemented purchasing strategies. Although bias in research is difficult or impossible to eliminate, it is the researcher's responsibility to recognize, acknowledge, and eliminate as much bias as possible that they may bring to the research (Cypress, 2017; Sica, 2006; Wadams & Park, 2018). Cognizant of my biases, I approached the interview as a researcher seeking knowledge and understanding. Both McCuster & Gunaydin (2014) and Mehra (2002) stated that in a qualitative study, knowledge is created during the researcher's interaction with participants. Therefore, I recorded the interviews and collected archival records, which helped me ensure that my views were not included in the findings. As a social researcher, my role was to follow the interview protocol and report the participants' perspectives on the research topic.

Conducting ethical research is an integral part of qualitative research. Byerley et al. (2017) argued that upholding ethical standards in research from the research design stage to the research findings stage is the researcher's responsibility. According to the Belmont Report, the research process should conform to ethical principles, including beneficence, justice, and respect for participants (Favaretto et al., 2020; Sims, 2010). The

researcher's responsibility is to respect, protect, and foster trust during and after the data collection process. Researchers should maintain confidentiality and provide for the personal safety and well-being of participants (Corbin & Morse, 2003; Friesen et al., 2017). As a researcher, I incorporated the elements of the Belmont Report by being mindful of participants' time and providing interview questions ahead of the date of the interview. Additionally, I offered an interview schedule that allowed participants to be comfortable to divulge information without fear of a reprimand. Sharing the interview questions and explaining the time limit for the interview before and during the interview helped both interviewee and me as interviewer stay on task.

Participants

Research participants play a primary role in data collection. Therefore, it is necessary to carefully consider who participates in the sample from which data is collected to answer the research question (Saunders, 2012). In choosing research participants, Saunders (2012) argued that it should be based on the focus of the research, ability to gain access, and appropriateness of the sample size. Based on the focus of my research, the main selection criteria were four purchasing executives in the automotive sector. These leaders had the job title of Vice-President, Senior Manager, and Manager. All the participants were responsible for formulating and implementing purchasing policies for their organizations. Additionally, the purchasing executives had been in the role for a minimum of 5 years at the time of the interview.

After I identified the qualifications of the participants that I intended to interview for this study, I developed a strategy to gain access to them. I located the executives

through their profiles on LinkedIn and sent a short note on my interview intention. Desroches (2020) advised researchers to utilize social media to locate participants to reach a larger group of possible participants. Using keywords in the LinkedIn search tab like *Vice-President purchasing in the automotive sector* allowed me to create a shortlist of potential interviewees that consented to the interview. After receiving Walden University IRB approval (01-10-22-1020338), I sent a formal letter to the selected participants, informing them of the interview questions and the time it would take to be interviewed. The interview date and time were at the discretion of the participants. The participants opted for a Zoom interview.

Due to the similarity in work experiences of the purchasing executives, I selected participants using homogenous purposive sampling. Researchers use homogenous purposive sampling for participants who share similar traits or similar work experiences (Etikan et al., 2016). This sampling technique involves identifying and selecting participants that are proficient and well informed about the phenomenon (Etikan et al., 2016). Though the purchasing executives had different strategies for managing material costs, they often purchased the same or similar materials.

Lastly, I scheduled the interview date with the selected participants using Google calendar and followed up with a phone call 2 days before the scheduled interview. Blakeslee and Fleischer (2019) advised researchers to develop a good working relationship with participants by communicating regularly with them. Communication to participants should also cover both the benefits and risks of participating in the interview.

Effective communication with participants ensures a good quality interview, builds trust, and establishes a working relationship.

Research Method and Design

Choosing the right research method and research design could lead to valid findings that are reliable for future research decisions and results. The research question drives the choice of a research method (Vandermause et al., 2017). In deciding which methodology to use in research, researchers need to understand that the choice of methodology directly impacts the outcome of the findings. I chose a qualitative method and a multiple case study design for this study. Qualitative methodology was appropriate because it is a means for exploring and understanding the phenomenon by using open-ended questions to proffer insights into the human experience and behavior (Castellan, 2010; Cypress, 2018; Kankam, 2020). Similarly, a case study design was necessary because I was looking to explore participants' real-life decision-making experiences as they occur in the workplace (Kruth, 2015). The multiple case study option was selected because it explores a broader scope and adds observations for the study without taking the research design into more quantitative terrain (Mahapatra et al., 2021; Stewart, 2012). In this subsection, I expounded on the justification for the choice of my research method and research design.

Research Method

I conducted a qualitative study. The qualitative research method is a means for exploring and understanding the phenomenon by using open-ended questions to proffer insights into human experiences and behaviors (Castellan, 2010; Mahapatra et al., 2021;

Nilmanat & Kurniawan, 2021). Qualitative researchers study complex situations subjectively and conceptually (Sutrisna, 2009). The open-ended questions and the conceptual nature of qualitative research allow the researcher to understand the phenomenon holistically. Vandermause et al. (2017) added that the qualitative method is used to generate textual data by identifying underlying reasons and motivations for action. Using a qualitative study method enabled me to understand the daily steps that purchasing managers take in formulating strategies for managing material costs.

Additionally, the qualitative methodology allows the researcher to be flexible in data collection. Vandermause et al. (2017) noted that qualitative researchers could access relevant data from peer-reviewed materials, in-person meetings, and archival data. Similarly, Yin (2014) suggested six ways a researcher can adopt to get a holistic view of the phenomenon, including: (a) documentation, (b) archival records, (c) interviews, (d) direct observation, (e) participant observation, and (f) physical artifacts. The various sources of data collection give flexibility to the qualitative method of research. I primarily conducted interviews, and I used documentation and archival records in my study. The qualitative method was appropriate for this study because I explored purchasing managers' motivation and strategies in managing material costs.

The quantitative method was not appropriate for my study because it involves using statistical data to address the research question. Daneault (2018) described quantitative methodology as a research method that is based on experimental models in predicting the phenomenon statistically. Quantitative research involves several variables and how the variables are related or dependent on one another (Bougie & Sekaran, 2019).

Since I did not test variables or approach my research from a numerical or objective point of view, a quantitative method was not suitable. Another research method that was considered is the mixed-method approach. The mixed-method approach is a combination of qualitative and quantitative methods. Both Almalki (2016) and McKim (2017) stated that mixed methods involve both numeric and narrative data. As a result, I did not select a mixed-method approach because my study did not include numerical analysis or test a hypothesis. I, therefore, selected the qualitative method for this study because I intended to gain insights and understand the strategies automotive purchasing managers use in managing material costs.

Research Design

I chose the multiple case study design for my study. Case studies are appropriate because they go beyond descriptions to provide a researcher with an in-depth inquiry into a phenomenon (Anyan, 2013). Case studies are suitable for exploratory research that addresses the *how* and *why* questions (Gaikwad, 2017; Yin, 2018). Researchers use case studies to study a real-life phenomenon (Ridder, 2017). A researcher understands the phenomenon through multiple data sources with multiple case study designs. Multiple case studies were chosen over single case studies because a single case design only uses data from one case (Morse, 2015; Yin, 2018). Yin (2018) explained that multiple case studies allow the researcher to collect rich data from various sources. The multiple sources of data provide a comprehensive and holistic view of the phenomenon.

Although case studies have been considered to lack objectivity compared to other research methods, they represent unique insights that may not be achievable with

comparable methods. For example, in new research areas where the preliminary or exploratory stage of a research project is required, case studies are helpful to provide a basis for the development of structured tools necessary for surveys and experiments (Eisenhardt, 1989; Nilmanat & Kurniawan, 2021). The variety of evidence ranging from interviews, observations, and documents supports the deeper-oriented and detailed investigations required to answer the research question in a multiple case study. Lastly, case studies are appropriate for this study because they explore a phenomenon as they occur within systems or groups. They are quicker, cheaper, and modest.

Other qualitative research designs such as phenomenology, narrative, and ethnography were not appropriate for this study. Phenomenology does not offer the variety of evidence that case studies present. Instead, phenomenology design studies a phenomenon as seen through the eyes of those who have experienced it (Engward & Goldspink, 2020; Yilmaz, 2013). Cypress (2018) added that phenomenology design is suited for researchers who want to understudy the inner essence of the participants regarding some shared experiences and have a personal sense of what it feels like to experience the phenomenon. In this instance, I did not need to identify single or several individuals with shared human experiences with a phenomenon. Additionally, I would not be able to use ordinary observation to gather evidence, but I would have to engage with the participants fully. Doing this involved a lot of time, effort, and cost.

In a narrative design, I would be narrating the spoken words of individuals. The narrative design follows a storytelling approach in maintaining a chronology of events (Campbell, 2014; Visser et al., 2019). Narrating the story as told by the participants was

not appropriate for this study because it did not allow me to add additional data sources. Similarly, ethnography was not suitable because it involves studying group members in their natural setting (Saunders et al., 2015). I did not seek to understand the influence of social and cultural norms related to the phenomenon. Therefore, ethnography was not appropriate for this study. I chose a multiple case study design because I sought to study automotive purchasing managers' strategies in managing material costs.

In conducting a qualitative multiple case study, being mindful of data saturation is essential. Palinkas et al. (2015) described data saturation as the point when additional data no longer adds a new meaning or information to the research. Achieving data saturation is ideal in a qualitative study because it ensures that enough data has been collected to show a holistic understanding of the phenomenon (Morse et al., 2014; Palinkas et al., 2015). I continued interviewing and collecting relevant documents until I reached data saturation, and no new themes emerged. After achieving data saturation, I constructed a saturation grid to monitor the emerging themes.

Population and Sampling

The population for this study was purchasing managers in the automotive industry in the United States. The purchasing managers were executives at the helm of affairs in the organization, and they were responsible for making purchasing decisions. I interviewed four purchasing executives. Hennink et al. (2017); Onwuegbuzie and Leech (2005) recommended a sample size of 4 to 10, depending on the nature of the study. The study population of 4 is in line with current case study trends and practice. The purchasing executives that I interviewed have been in that role for a minimum of 5 years.

Lane and Hennes (2018) advised researchers to determine the minimum sample size necessary to have a high probability of concluding the study. However, the factors to consider in determining sample size are the population effect size, the correlation between repeated measures, and the research design (Anderson et al., 2017). For my multiple case study, four purchasing executives were enough sample size to identify meta-themes and reach data saturation.

I used purposive sampling as the sampling style for my study. Etikan et al. (2016) noted that purposive sampling reduces the need for many participants and improves the generalizability of the data collection process. Researchers use purposive sampling because each participant would provide unique and rich information valuable to the study (Lee-Jen et al., 2014). In purposive sampling, population members are not interchangeable, and the sample size is determined by data saturation (Lee-Jen et al., 2014). Purposive sampling allowed me to optimize the vast experience of the high-level participants. However, I had planned to use the snowball sampling technique as a secondary sampling method if I did not reach data saturation from the sample size. The snowball sampling is vital for finding additional participants to address the research question (Gentles et al., 2015). The additional participants I would have included in the study are supply chain managers and logistics managers. A snowball sampling technique is necessary to reach data saturation and increase the sample size.

Ethical Research

I gained approval from Walden's University Institutional Review Board (IRB) before communicating with participants. The Walden IRB approval number for this study

is 01-10-22-1020338. After receiving IRB approval, the first step I took was to invite and gain consent from the participants. In the consent form, I informed participants of the risks, benefits, and the option to withdraw or discontinue from the process at any time. Participant consent is a vital requirement for conducting a study (Nishimura et al., 2013). Researchers need to obtain permission from participants on their willingness to participate in the study and an understanding of the risk associated with the research (Dankar et al., 2019). A signed consent form would indicate awareness and adherence to ethical standards of research. Participants were reassured that the data collected would be confidential and would not be shared with other participants. Additionally, I ensured that participants felt protected and comfortable throughout the research period.

Participation in this study was voluntary. In accordance with the Belmont Report on respect for persons, researchers must relate with participants as independent and protect less-independent participants (National Commission for the Protection of Human Subjects and Biomedical and Behavioral Research, 1979). I highlighted the independence of participants in the consent form and stated that they were not coerced or incentivized to participate. Other aspects of the Belmont Report that were adhered to are beneficence and justice (National Commission for the Protection of Human Subjects and Biomedical and Behavioral Research, 1979). Beneficence and justice in this study refer to making the participant's protection paramount before, during, and after the research process. Data collected was saved in a hard drive and stored safely in a fireproof cabinet. Both archival data and interview data would be stored for a minimum of 5 years. After the 5 years required to keep data, I will dispose of all data securely and safely. I did not identify

participants' real names or organizations, or locations. The names of all participants are assigned pseudo names ranging from P1, P2, P3, and P4. Similarly, the names of the organizations are assigned pseudo names ranging from C1, C2, C3, and C4. The Walden University Institutional Review Board (IRB) approval number for this study is 01-10-22-1020338, and it expires on September 01, 2023.

Data Collection Instruments

As the interviewer in this study, I was the primary collection instrument, and the primary source of collecting data was through semistructured interviews. Yin (2018) stated that semistructured interviews are effective for a qualitative study. Semistructured interviews allow flexibility in the interview process and thus, enable the researcher to collect in-depth information (Akintola & Chikoko, 2016). Researchers can explore the experiences and motivations of the participants during the interview process (Tran, 2016; Yin, 2018). The flexibility in a semistructured interview is essential in probing into the strategies that automotive purchasing managers use for managing material costs. Using interviews as a source of data collection is reliable because participants will exchange their views and thoughts face to face with the interviewer.

To enhance the reliability and validity of the interview process, I recorded the interview process on Zoom and a Sony recorder. I tested and practiced using the Sony recording device before the interview. Majid et al. (2017) noted that adequate preparation is necessary for a successful interview. I followed the interview protocols as outlined in Appendix A in preparing for the interview. The interview protocol contained 7 open-

ended interview questions. I used the interview questions and archival documentation to collect data related to strategies for managing costs.

Qualitative researchers need to ensure that the data collection process is credible and dependable. To ensure that the data collected from the participants were accurate, I used member checking through transcription to validate the data. Member checking is an effective way to get participants to check the data and re-confirm the data (Rosenthal, 2016). In some cases, during the member checking process, the participants may add new information to enrich the data further (Moon, 2019; Morse, 2015; Yin, 2018). Engaging participants before, during, and after the interview builds an effective relationship that helps add value to the research. Lastly, I will share a summary of the findings with each participant to review and confirm the interpretation of the data they provided.

Data Collection Technique

Planning for data collection is integral to the research process. Chu & Ke (2017); Conner (2002) noted that data collection planning helps create, develop, and refine the proposed theory. Using multiple sources to collect data ensures that the research is valid and credible (Yin, 2018). Yin (2018) suggested four principles for managing data in a qualitative study includes: (a) multiple data sources, (b) creating a database, (c) chain of evidence, and (d) exercise care. My data collection technique comprised semistructured interviews, archival records, company documentation, and reports. Rosenthal (2016) advised qualitative researchers to use an effective interview protocol to provide the best information from multiple participants to achieve triangulation. Therefore, the combination of company documentation and the interview protocol outlined in Appendix

A helped me achieve triangulation in my study. Additionally, the interview questions in section 1 provided consistency in the data collected from the different participants.

Although semistructured interviews are beneficial to a qualitative study because of their flexibility, they are also time-consuming. The time it takes to schedule an appointment with very busy executives and the time it takes to conduct multiple interviews can be burdensome. Gaikwad (2017) stated that data collection in case studies takes a long time, like ethnographic research design. The time to conduct a case study includes interviews, transcribing data, document review, and member checking, making the research process seem very long and arduous. However, I sent out a copy of the interview protocol and interview questions to the participants before the interview date. Additionally, I transcribed and sent out the transcribed data for member checking as I continued interviewing other participants. Researchers are expected to develop a plan of action to answer the research question (Saunders et al., 2015). I was flexible with the interview channel. Participants had the option of either a face-to-face interview or a zoom interview. All participants opted for a Zoom meeting. Roberts et al. (2021) mentioned that COVID-19 had caused participants to prefer virtual interviews instead of face-to-face interviews. Therefore, I conducted all the interviews using Zoom and emailed participants the transcribed data for member checking.

Data Organization Technique

Another data collection principle is organizing, storing, and documenting data. I used NVivo software to organize the collected data. An adequately organized database would aid the researcher in retrieving data quickly and make it accessible to external

readers (Yin, 2014). For example, notes can be put together by themes, or a chain of evidence can chronologically show a build-up of the case. Robins and Eisen (2017) stated that NVivo software helps qualitative researchers record, analyze, and display data. Maintaining a chain of evidence adds validity, reliability, transferability, and credibility to the study. Therefore, readers can trace the steps taken by the researcher and understand how the evidence leads up to the conclusion. If data is not properly organized, it would be difficult to back-test the study's findings to see how the researcher arrived at them.

There are different software programs and Microsoft office tools that can help with organizing and storing data. Yakut et al. (2017) argued that using computer software for organizing data provides significant benefits to the research process. Considering the need to store data for a minimum of 5 years, I ensured that the digital tools used for storage were secure. Camfield (2019) suggested that researchers should ensure that their data storage tool is safe, secure, and confidential. Following Walden's University requirement for data storage, I will store all data obtained from this study on a password-protected hard drive for 5 years. After 5 years of this study's completion, all the data will be deleted and destroyed.

Data Analysis

Qualitative data analysis involves thoroughly examining the different data sets collected from the interviews, documents, and archival data. The purpose of reviewing the data sets is to find more themes and patterns related to the study. Sequencing raw data allows the researcher to identify themes and recurring patterns that will help lead to the study's findings (Barrett & Twycross, 2018; Health et al., 2018; Maher et al., 2018;

Saunders et al., 2015; Yin, 2018). I used thematic analysis for my data analysis. Then, I indicated how the themes aligned with my study's conceptual framework. An excellent data analysis that fits the research design may produce valid and reliable results.

When choosing which data analysis to use for research, researchers need to consider the study's research design. In a case study, data triangulation provides crystal refraction or many points of light to extrapolate the meaning inherent in the data (Fusch & Ness, 2015). Triangulation of data is an approach to data analysis for taking the many sides of the argument to formulate or find common points of agreement or disagreement. The four triangulation methods are methodological, investigator, data, and theory triangulation (Yin, 2018). Researchers use theory triangulation when the study involves more than one theory, and investigator triangulation is used when multiple researchers undergo the study. Similarly, researchers use data triangulation for collecting data sets over a specific period. Methodological triangulation, however, was most suitable for my study because of the multiple sources of data that were collected (Fusch et al., 2018). The data sources of this study were semistructured interviews, documentation, and archival records. Using methodological triangulation validates the study's outcomes, improves objectivity, and eliminates biases (Fusch et al., 2018; Johnson et al., 2017; Joslin & Müller, 2016; Yin, 2018). I applied the methodological triangulation approach to triangulate data collected from the interviews.

It is essential to organize the data into data sets for analysis when collecting data. The five steps Yin (2018) suggested that researchers can follow for data analysis are: (a) compiling, (b) disassembling, (c) reassembling, (d) interpreting, and (e) concluding.

Following Yin's five steps in research ensures consistency in data analysis and provides the guide rails for reaching data saturation. Various software programs like the NVivo 12 are useful in conducting Yin's five steps of data analysis. Researchers use the NVivo software program to organize, harmonize, and code data to find common themes (Oliveira et al., 2016; Sutton & Austin, 2015; Whitmore et al., 2018). I used NVivo software for this study to compile, disassemble, reassemble, interpret, and conclude as suggested by Yin's five step analysis.

Reliability and Validity

Reliability

Assessing the reliability and validity of a qualitative study is one of the concerns in research. Unlike a quantitative study that involves statistical methods for establishing reliability and validity, qualitative researchers aim to design methodological strategies that will ensure reliability, validity, and transferability (Noble & Smith, 2015). Research reliability refers to the appropriateness of the adopted procedure and the accuracy of the result analysis (Saunders et al., 2015). The reliability of a study underpins the dependability, replicability, and consistency in the research process. Both the quality of the study and the rigor of the design contribute to the study's reliability and validity (Darawsheh, 2014; Fusch & Ness, 2015). To ensure rigor in a study, qualitative researchers seek credibility, confirmability, transferability, and dependability (Wamba et al., 2015). By following a methodological approach that can eliminate both researcher and participant bias in collecting, recording, and storing data, a researcher can show transparency and improve reliability.

Researchers can use different strategies to show the reliability of a study. Some of the strategies that researchers can use in establishing rigor in a study are: (a) member checking, (b) audit trail, (c) triangulation, (d) peer-review, (e) reflexivity, (f) data saturation, etc. (Bernardi & Steyn, 2019; Retke et al., 2018; Spiers et al., 2018). Using member checking, participants can confirm and validate their earlier responses for accuracy (Harvey, 2015; Iivari, 2018; Saunders et al., 2015; Thomas, 2017). I informed participants during the interviews that I would be returning for member checking to confirm and validate their responses. After transcribing the data, I sent the relevant portions of the interview to participants for validation. Iivari (2018) stated that during member checking, a researcher could improve the study's dependability by identifying errors, misinterpretations or collecting additional data. The additional forms of establishing reliability that I utilized are methodological triangulation and audit trail. Johnson et al. (2017) defined methodological triangulation as a method of using multiple sources to collect data. The consistent data from the multiple sources that I used helped me re-affirm the reliability and dependability of my study. Building a solid chain of evidence involves creating an audit trail that others can look at and understand if they wish to do so. A researcher can create an audit trail by outlining the decisions made throughout the research process to provide a rationale for the methodological and interpretative judgments (Houghton et al., 2013). According to Koch (1994) and Mayernik (2017), a researcher can establish a study's trustworthiness if the reader can audit the researcher's events, influences, and actions. I followed the interview protocol as stated in Appendix A and interviewed all participants using the same open-ended

interview questions. Though the readers may or may not share a researcher's point of view, they should nonetheless be able to discern how it has been reached.

Validity

Validity refers to how the findings accurately reflect the data collected. The appropriateness of the data beginning from the data instrument to the data analysis process, indicates the validity of the study (FitzPatrick, 2019; Heale & Twycross, 2015; Leung, 2015; Morse, 2015; Spiers et al., 2018). Researchers access validity by data saturation, transferability, confirmability, and credibility (Yin, 2018). To ensure the validity of a study, a researcher can use various methods, including (a) audit trails, (b) member checking, (c) interview protocols, (d) triangulation, etc. (Yin, 2018). In general, an excellent way to achieve validity is to ensure that the research process is thought through and evaluated and does not contain logic leaps and false assumptions. Results of the study should be fully transparent to allow others to judge for themselves and replicate the study if they wish to do so. I ensured that participants agreed the transcribed data reflected the main points of the interview. The participants made no further additions to the transcribed data.

Credibility

Credibility refers to the value and believability of the findings of the study. Moon (2019) stated that for a study to be believable and authentic, the study must show rich and detailed collected data. Establishing a transparent process in the interview process will aid in adding credibility to the study (Parsons et al., 2017). Researchers may use either member checking or methodological triangulation to enhance credibility. Both Harvey

(2015) and Thomas (2017) agreed that researchers should use member checking to establish credibility. Therefore, I used member checking and methodological triangulation to ensure credibility. I ensured that participants agreed the transcribed data reflected the main points of the interview and no changes were needed.

Transferability

Transferability refers to whether the findings of a study can be transferred to another similar context or situation while still preserving the meanings and inferences from the completed study. The transferability of research stems from the description of the study in rich and elaborate detail to aid other researchers in engaging in the same study within a different setting (Daniel, 2018; Gallagher, 2019; Weis & Williams, 2017). In terms of transferability, I collected a lot of data from four different organizations and provided sufficient detail in my analysis and presentation of findings.

Confirmability

Confirmability in research signals accuracy and objectivity in the research process. Johnson and Rasulova (2017) noted that confirmability in research shows that the research was without bias but reflects the accurate views of participants. Qualitative researchers can use either audit trails or reflexivity to ensure confirmability in research (Bengtsson, 2016). As a researcher subject to my own views, I ensured that I used an audit trail that showed a detailed description of the steps, procedures, and interpretation methods in my reflective journal to help me reflect on my experiences in this study. Maintaining an audit trail helped me achieve confirmability in my study.

Data Saturation

Data saturation is the point where additional data no longer adds new themes and thus, becomes repetitive. The repetitiveness of the same data proves the validity and trustworthiness of the study. Fusch and Ness (2015); Moser and Korstjens (2018); Saunders et al. (2015); noted that qualitative researchers reach the point of data saturation when further coding is no longer possible and no further new insights are gained. I continued interviewing participants until no new themes emerged. After the fourth participant repeated the same thing as other participants, I stopped interviewing new participants. When additional information no longer added new insights to my study but became repetitive, I stopped interviewing new participants because I reached data saturation and thus, achieved validity.

Transition and Summary

The purpose of this qualitative multiple case study was to explore strategies that some purchasing managers use for managing material costs. In Section 2 of this study, I stated the purpose of the study, my role as a researcher, the participants of the study, and the research method and design. Furthermore, I outlined the population and sampling for the study, ethical concerns, data collection instruments, data organization techniques, and data analysis. Finally, I explained what reliability and validity mean to me and the steps that I will take to ensure that the outcome of this study is reliable and valid. Each sub-topic in Section 2 contained scholarly peer-review articles and seminal works that supported my position.

In Section 3, I discuss the findings from my study, application to professional practice, implications for social change, recommendations for action, and future research.

The study's results comprise the themes identified and link to the study's conceptual framework. Additionally, I share my reflection on the experiences gained in conducting this study and provide summary and study conclusions.

Section 3: Application to Professional Practice and Implications for Change

The objective of this qualitative multiple case study was to explore strategies purchasing managers use for managing material costs. I used purposive sampling to identify and select four purchasing managers from automotive companies who had formulated and implemented strategies for managing material costs. Participants were interviewed following the interview protocol in Appendix A. I conducted semistructured interviews using the Zoom application to collect data for my study. Based on the data collected and the data analysis, five themes were identified as purchasing managers' strategies for managing material costs. The themes identified include (a) negotiation, (b) total cost of ownership, (c) reducing design complexity, (d) supplier strategic relationship, and (e) role of information technology. In this section, I present the findings of the study, applications to professional practice, implications for social change, recommendations for action, and further research. Additionally, I outline my reflections on the research process and conclude the study.

Presentation of the Findings

The overarching research question for this study was: What strategies do automotive purchasing managers use for managing material costs? The themes found in my research included (a) negotiation, (b) reducing design, (c) supplier relationship, (d) total cost ownership, and (e) role of information technology (Information Tech). In providing answers to the research question, I used semistructured interviews with four purchasing managers in the automotive industry to collect data. Then, I used NVivo software to organize the collected data and conduct thematic analysis. Researchers use

semistructured interviews to gain insight and understanding into the phenomenon (Gaikwad, 2017). I continued interviewing participants until no new themes emerged, thus reaching data saturation. Researchers who used the qualitative method reach data saturation when no further new insights are gained (Fusch & Ness, 2015; Moser & Korstjens, 2018; Saunders et al., 2015). After the third participant's interview, the responses were repetitive and similar to the earlier interviews. I continued to the fourth participant's interview, and no new information was obtained. At that point, I determined that I had achieved data saturation.

I used code names for both the participants and the organization to maintain participants' privacy. The code names for the participants were P1, P2, P3, and P4. Similarly, the code names for the companies were C1, C2, C3, and C4, respectively. The participants were either managers, senior managers, or vice presidents of purchasing in their organizations. I used the purposive sampling technique to identify and select participants with the most experience in purchasing managers' strategies for managing material costs. Researchers use purposive sampling to identify participants that can add unique and rich information to the study (Lee-Jen et al., 2014). All the participants provided candid and elaborate responses to the interview questions. Table 1 summarizes participants' qualifications that participated in the study.

Table 1

Participants positions in their organizations

Participants	Vice President	Senior Manager	Manager
4	1	2	1

I recorded the interview using a Sony audio recorder as the primary recorder and recorded the interview on Zoom as a backup to the primary recorder. After the interviews, I uploaded the audio file using the dictate dropdown menu on Microsoft 365 Word program to transcribe the data. A summary of the transcribed data was emailed to the participants for member checking. Thereafter, I used NVivo software for the coding and thematic analysis. All participants contributed to the development of the themes. The themes identified from this study support the conceptual framework, RDT, and outline the strategies for managing material price increases from suppliers responsible for critical organizational resources. Table 2 displays the number of participants that support each theme.

Table 2

Percentage of Participants Supporting Each Theme

Themes	Participants	Percentage
Negotiation	3	20%
Reducing Design	3	20%
Supplier Relationship	3	20%
Total Cost of Ownership	3	20%
Role of Information Tech	3	20%

Theme 1: Negotiation

Three participants mentioned negotiation as one of their strategies for managing material costs. P1 stated that “negotiating price increases is essential to managing material costs.” Unfavorable CPV can cause detrimental financial effects on the firm (Gaudenzi et al., 2020). P3 noted,

In terms of negotiations, material price increases are often met with a formal rejection letter. When there is an existing contract covering the services, suppliers are persuaded to uphold the terms of the contract and continue services without any price increases. Sometimes the rejection strategy works, but when it does not give the expected results, we utilize third-party data management tools to check if the price increase is fair.

P1 added that:

The third-party tools can be in the form of indexes or a paid commodity price tracking service. Many commodities such as natural gas or coal are tracked on Wall Street, and anyone can monitor or track the going rate. However, other commodities like magnesium or other metals are tracked by specific organizations, and they create an index. Some purchasing managers use this index as a guide to determine if they are paying the appropriate amount or paying over or under the index. Most purchasing managers tie their deal to that index depending on the negotiation. Any additional cost, such as freight, overhead, profit, etc., is added to the index. For example, a purchasing manager can negotiate with a supplier to pay the index plus 4% adder to cover additional costs. Whatever percentage that is added to the index is usually pre-negotiated and agreed upon.

Ultimately, the process of dealing with commodity price volatility is to ensure that no party in the relationship loses. In an inflationary period where material prices are

increasing astronomically, getting the right parts in the right quantity takes precedence over the right price. P2 mentioned:

Simply asking for price reduction doesn't work in an inflationary market. The key to managing material costs is understanding the commodity's local market and the global market. Purchasing managers that do not know the market enough may be unsuccessful in accomplishing cost-level targets. Understanding the developments and challenges that the supplier is facing and understanding the supplier's flexibility is essential for effective negotiation.

The findings of this study confirm that negotiating material price increases is a critical aspect of managing material costs. However, some purchasing managers may find it difficult to use the negotiation strategy when dealing with low-cost suppliers (Pongsuwan, 2016). Purchasing managers need to find new methods of purchasing materials to ensure that the organization is receiving the best value for money. The RDT conceptual framework aligns with the negotiation theme, especially when sourcing critical parts for the organization. Pfeffer and Salancik (2003) used RDT to explain how organizational leaders can collaborate and work with their significant resources like suppliers to manage material costs and improve profitability. P3 mentioned, "at some point in the negotiation, we would look at what is causing the cost increase on the partner side and try to absorb a certain percentage of their cost." Company profitability depends on its ability to cooperate with suppliers in the face of price volatility to ensure that resources or materials are acquired for continued production (Zou et al., 2019).

Therefore, mitigating commodity price volatility through effective negotiation strategies in the supply chain can reduce material costs and create financial benefits for the firm.

Theme 2: Total Cost of Ownership (TCO)

The second theme that emerged from the data analysis and document review is the TCO. Automotive suppliers bid for orders based on the production process cost estimates (Andrea et al., 2020). The production process comprises several cost centers and operations linked by intra-plant logistics. P2 mentioned,

In purchasing materials, the first step is to understand the cost elements and the cost structure of the materials. TCO is the process of understanding and calculating the total cost of procuring material and bringing it into the plant. We use cost engineers to dissect and analyze the cost structure of materials. In analyzing the cost structure of the materials, the cost engineers look for opportunities within the cost structure to improve the cost of the cost drivers. For example, the cost engineers can identify a gap in the freight and logistics side and develop a strategy to localize the sourcing.

Purchasing decisions are influenced by many factors other than price. Literature by Palmer et al. (2018) corroborated the concepts in Theme 2. Palmer et al. (2018) presented a report on assessing the total cost of ownership of conventional, hybrid, plug-in hybrid, and battery electric vehicles. Hybrid electric vehicles have a high price premium compared to conventional cars. In assessing the total cost of ownership, Palmer et al. (2018) combined the purchase price and operating expenses to identify the vehicle's

most economical choice. The operational expenses could include freight, logistics, overhead, insurance, etc. P1 stated,

The current Olympics in China has caused a supply shortage of magnesium because manufacturing plants are closed to reduce smog. The shortage of magnesium and the increase in freight costs could affect the total cost of metals ownership. Therefore, an effective purchasing manager should anticipate global events or supply uncertainties that can potentially affect the total cost of ownership.

Purchasing managers may use TCO in either a *make or buy decision* or in determining the TCO of one material over another. The analytical method of using TCO can be effective in providing support for a purchasing decision. P2 mentioned, “TCO is helpful for us in determining what location to source material from a cost-benefit standpoint.”

The RDT conceptual framework aligns with Theme 2. As businesses depend on suppliers for materials, they need to evaluate the total cost of ownership of materials constantly. Klein and Pereira (2016) stated that in forming a supplier relationship, an organization would have to manage its dependence in relation to other members. Using TCO techniques provides a cost-based analysis of the commodity purchasing process and sets priorities regarding cost-saving opportunities and excellent data for negotiations (Gaudenzi et al., 2020). Dynamism in cost attributes is not a delusion, but understanding, managing, and tolerating them is essential to project success and stakeholder satisfaction (Oluwole et al., 2018). The total cost of ownership is a barometer to determine whether one supplier is cheaper than the other.

Theme 3: Reducing Design Complexity

The third theme that emerged for the data analysis and document review is reducing design complexity. Three participants agreed that reducing design complexity or replacing one material with a lower cost one has been an effective strategy in reducing the cost of materials. P1 commented,

There is a strategy behind everything. So, building a strategy document for every commodity is very important. One of those strategies is having a parallel path with the engineering group to determine what material to use for automotive parts and how to replace expensive materials with cheaper materials. For example, a pocketknife has a content of 80% silver and 20% iron. Knowing that silver is more expensive than iron, the strategy around reducing design complexity would be how can we drive more silver out of the design of the pocketknife? How can we get the customer to approve a design with a lower-cost material? Instead of using gold, can we use cast iron? Though cast iron may be heavier, it is a cheaper material. These are some of the questions we would include in our strategy document to reduce design complexity. Design solutions may be excellent from the assembly point of view but may not be cost-efficient in manufacturing costs and investments (Favi et al., 2016). Nonetheless, it is usually difficult to get an automotive customer to approve a material change, especially if it is a safety part, but they may make a change if it's early in production.

For P2, "reducing design complexity can mean taking steps to improve the cycle time on a forging or stamping process." P4 stated that "reducing tooling costs by using

other sub-vendors helps to reduce design complexity.” Various process changes can substantially impact costs. Dhiravidamani et al. (2018) conducted a case study in a foundry division of an auto parts manufacturing industry to understand how implementing Kotetsu-kaizen and value stream maps could improve the manufacturing process flows. To understand the phenomenon, Dhiravidamani et al. (2018) used the present value stream map and the cause-and-effect diagram, also known as a fishbone diagram, to visualize activities and analyze data in the production process. The objective of the process was to reduce the processing time, set-up time, non-value-added time, and core rejections. Supply chain managers use Kaizen concepts to identify improvements that can be implemented without additional expenses and changes in design (Dhiravidamani et al., 2018). The study results conducted by Dhiravidamani et al. (2018) showed a 60% improvement in non-value-added activities in the shop floor area per machine. Additionally, the average core rejection was reduced by 2.02%, indicating that the proposed system in the core shop reduces the rejection rate. Strategic flexibility and manufacturing flexibility are the critical antecedents of supply chain agility.

The availability of critical materials and data on time is necessary for a successful manufacturing process. Ramakrishna et al. (2019) stated that material informatics helps in computationally mining and analyzing large ensembles of experimental and modeling datasets efficiently and cost-effectively. Material informatic could transform the manufacturing process and help reduce production cycle time and production costs. The RDT conceptual framework aligns with Theme 3. The dependence level between one organization and another for critical resources will determine the basis of power or

influence in making design changes. Pfeffer & Salancik, 2003 noted that the organization with the most access and control over resources forms the basis of power. P1 mentioned,

We need to have a parallel path with engineering and find ways to influence them to make material changes. How do we use that material, and how do we drive the more expensive material out of the design? It takes a lot of convincing and disagreements to try to reduce design complexity. Also, getting the automotive customer to replace that part with a cheaper one is very difficult, especially if it is a safety-related automotive part.

The concept of RDT stems from the idea that external factors such as the basis of power to influence design changes can affect material cost management.

Theme 4: Supplier Strategic Relationship

The fourth theme that emerged from the data analysis and document review is supplier strategic relationship. P3 stated,

Business relationships are initiated and developed by people. When you have a key relationship, you want to get to know the person to understand what they are capable of doing and what they are not capable of doing with an intent to have a win-win solution. Finding the right partner that will not take advantage of minimal market shifts to change material prices is essential to developing long-term strategic supplier relationships. With a strategic relationship, we can do a better job in sharing forecast information to guarantee capacity. In the year 2020, when Covid-19 broke, most automotive manufacturers stopped production, leading to shortages in semiconductors. Supply chain leaders manage inventories

based on min and max levels, and poor forecast communication can create a bullwhip effect and, therefore, increase operational costs.

Automotive suppliers play an important role in the innovation and manufacturing process (Trautrimis et al., 2017). Hence, selecting a supplier is a multi-dimensional decision consisting of creating value and the ability to innovate. P1 commented,

Re-evaluating the organization's supplier base is necessary to determine who we buy from and why do we buy from them. We may single source or buy from multiple sources. So, we determine why do we buy 30% of the material quantity from a particular source? It may be because of their location or price, or maybe the company's owner is friends with a plant manager. We just do not know.

Developing a capable supplier base is critical to supply chain performance and coordination. Collaborating with suppliers enables them to respond and adapt to supply uncertainties. P3 stated,

Identifying a supplier is the easy part of the process, but selecting a strategic supplier is very difficult.” Selecting a strategic supplier in an extremely cost-competitive market is difficult because we have to check if the supplier can comply with certain quality standards, safety, logistics requirements, and sustainability initiatives. When purchasing commodities where every cent counts, we are looking to develop a supplier that can sustainably be cost-competitive. Therefore, we will first understand their process, identify bottlenecks, and develop the best solution with them that will yield the lowest cost possible in the market. So, developing trust with the supplier is essential and understanding

whether they will be willing to invest in what is necessary is the basis for building strategic supplier partnerships.

The RDT conceptual framework aligns with Theme 4. Pfeffer and Salancik (2003) used the concept of RDT to explain how business leaders can collaborate with significant stakeholders to gain business value. P1 mentioned, “building sustainable supplier relationships helps us generate off-book savings from suppliers in the form of rebates.” From a resource dependency perspective, a firm’s systematic, sustained approach to risk management provides sustainable benefits to all supply chain partners and a competitive advantage over others. Additionally, implementing supplier integration, evaluation, and collaboration efforts in building strategic supplier relationships presents opportunities for developing core resource capabilities, leading to a competitive advantage for firms.

Theme 5: Role of Information Technology

The fifth theme that emerged from the data analysis and document review is the role of information technology. Though some organizations may not invest enough resources in improving their IT resources, the future success of companies will be a battle of IT-enhanced supply chains. Madhani (2016) stated that competition is no longer about firms but between entire supply chains. Firms that can use emerging technologies to improve synergy between manufacturing systems and communication technology will produce faster, cleaner, and better products. IT knowledge is necessary to enable firms coordinate business activities and utilize IT assets to provide the desired results (Neirotti & Raguseo, 2017). All participants agreed that every process is heavy lifting without the use of technology. P3 noted, “some big changes we have seen in our purchasing process

have been the deployment of IT technology such as big data, e-procurement systems, ERP systems, blockchain technology, and cloud computing. Zhang et al. (2019) described the digital supply chain as any instance in which information technology implementations and the traditional supply chain intersect. Businesses require data to make decisions, and managing extensive data can be burdensome. The ability to access information in real-time through the internet helps with strategic and operational decisions. Firms that can effectively use information and communication tools in their business activities gain a competitive advantage. P2 mentioned,

The IT tools for managing material costs have evolved over time. IT tools have saved time in purchasing analysis and helped support TCO analysis. We use P2statistical analysis tools to help us identify other cost drivers that may be affecting the piece price of material, such as the weight of the material or the location of the supplier. We can make quicker assertions on price estimates and compare supplier quotes much faster with this information.

Núñez-Merino et al. (2020) pointed out that the use of increased technological infrastructures facilitates information processing and helps develop a more reliable and resilient supply chain. IT skills and knowledge are necessary to enable firms to coordinate business activities and provide positive results (Neirotti & Raguseo, 2017). Digital technologies such as cloud computing and e-Procurement systems can help purchasing managers control the cost of business processes and improve accountability throughout the supply chain (Zhang et al., 2019). E-procurement technology can reduce transaction costs, minimize order cycles, and help purchasing managers make better

decisions (Pongsuwan, 2016). Purchasing managers that adopt an e-Procurement system in purchasing activities can provide a more efficient and cost-effective process. Applying IT technology in the manufacturing process could help reduce transaction costs, minimize order cycles, and help purchasing managers make better decisions.

The RDT conceptual framework aligns with Theme 5. Modern businesses no longer only differentiate themselves as low-cost providers or innovators but also need to use IT to automate and improve their processes. IT creates a competitive advantage and strategic weapon that is a new differentiation tool (Bobb & Harris, 2011). The conceptual framework of RDT stems from the idea that resources are integral to organizational development, and access or control over these resources forms the basis of power (Pfeffer & Salancik, 2003). P3 stated,

We spent days trying to get the kind of information that we can now generate with a few clicks on the computer. I remember when I spent 2 weeks trying to do a TCO analysis for a business case comparing a local supplier with a Taiwanese supplier. It took forever to get all the information we needed from the different sources. We have an IT tool that helps us visualize all the sources to make timely decisions.

IT capability creates a competitive advantage, but the competitive advantage is gained when IT has a powerful effect on cost (Porter & Millar, 1985). Companies' future success will be a battle of IT-enhanced supply chains. Qosasi et al. (2019) stated that these IT capabilities are required to adjust, integrate, reconfigure, and recreate internal and external competencies. According to Madhani (2016), competition is no longer about

firms but between entire supply chains. Firms that can use emerging technologies to improve synergy between manufacturing systems and communication technology will produce faster, cleaner, and better products. In this instance, the access or control over technological resources can limit the development of IT tools that can reduce the cost of materials.

Applications to Professional Practice

The objective of this study was to understand the strategies that purchasing managers use to manage material costs. The five themes that emerged from the findings are: (a) negotiation, (b) total cost of ownership, (c) reducing design complexity, (d) supplier strategic relationship, and (e) role of information technology. Purchasing managers can apply the results of this study to formulate purchasing strategies that can help reduce material costs and improve organizational profitability. Purchasing executives are responsible for spending over half of every dollar the firm receives as income from sales. More dollars are spent on the purchases of materials and services than for all other expense items combined, including wages, depreciation, taxes, and dividends. Núñez-Merino et al. (2020) stated that effective material managers conceptualize the company's supply chains to increase their efficiency, reduce cost, and operate in a lean manner. Therefore, this study's themes and findings could help purchasing managers develop practical strategies to manage material costs and reduce supply chain uncertainties.

Current and future purchasing managers can apply the strategies presented in this study to improve organizational performance and enhance competitive advantage.

Competition is no longer between firms but between entire supply chains (Madhani, 2016). Erevelles et al. (2016) noted that organizations' performance and competitive advantage are facilitated by both the organizations' tangible and intangible resources. Nowadays, companies can no longer gain a competitive advantage strictly by product differentiation or low-cost technique but now have to be more creative (Abdelkader & Abed, 2016). An effective purchasing strategy could be that intangible organizational resource that would enhance competitive advantage. Hence, purchasing managers can use this study's material cost management strategies to improve their supply chains and gain a competitive advantage.

Implications for Social Change

The implications for positive social change include developing sustainable partnerships that impact the entire automotive ecosystem in learning and technical capacity. When businesses develop one another and continue to grow the ecosystem's intellectual capital, they work together to improve the process and product performance. Supply partnership development strategies like technical investments or logistic integration improve local companies' economic and social performance (Yawar & Seuring, 2018). Local companies that hitherto lacked access to financial components or technological components will gain technical competence, business growth, and global exposure. Thus, the local companies will earn more income, create more job opportunities for local residents, and support local social programs.

Material cost is directly related to profitability. A dollar saved in material cost is a dollar gained in profit. The additional profits gained by implementing practical

purchasing strategies could allow organizations to invest more in social programs such as (a) providing scholarships, (b) reducing carbon footprint, (c) improving labor policies and wages, and (d) donating to developing countries. On the other hand, profitable businesses and employed local workers pay higher taxes to the government. These taxes, in turn, can be used by government officials to enhance social and economic programs for disadvantaged or low-income residents.

Recommendations for Action

Following the results and insights gained from the academic literature review, purchasing managers can potentially use the strategies identified and presented in my study to manage material costs. The themes identified include: (a) negotiation, (b) total cost of ownership, (c) reducing design complexity, (d) supplier strategic relationship, and (e) role of information technology can be applied in an automotive company to reduce the cost of materials and improve profitability. Based on the findings of my study, I recommend the following:

1. For effective negotiations, purchasing managers need to use third-party sources to benchmark pricing from suppliers. While counter proposals may work in certain negotiations, concrete and verifiable data drive the most effective negotiations.
2. Calculating the total cost of ownership is essential to know the true cost of purchasing materials. The purchasing function could have a team of cost engineers responsible for analyzing and calculating the total cost of ownership of all materials purchased by the organization.

3. The early involvement of purchasing managers in the engineering design of components is an opportunity to reduce design complexities. Material changes from a high-cost material to a low-cost material are important in reducing the cost of an automotive part.
4. Purchasing managers could regularly cultivate and develop strategic partnerships with suppliers to reduce supply uncertainties and price volatility.
5. Information technology will shape the future of supply chains because competition is no longer about firms but between entire supply chains. Firms that could use emerging technologies to improve synergy between manufacturing systems and communication technology would produce faster, cleaner, and better products. Therefore, purchasing managers need to pay attention to IT and utilize IT resources to automate their processes.

While I focused my study on the automotive industry, the findings can be applied to other industries. I will share the results of this research through business journals, scholarly publications, and professional journals. Current and future researchers will be able to access my research from *ProQuest/UMI dissertation database*, *Journal of Purchasing and Supply Management*, and *Supply Chain Management Journal*.

Recommendations for Further Research

The objective of my qualitative multiple case study was to explore strategies that automotive purchasing managers use for managing material costs. Though the results identified from this study were informative, the study's findings indicate the opportunity for further research. Continued research is required to understand additional strategies

purchasing managers use for managing material costs. As stated in my research prospectus, limitations refer to potential weaknesses outside the researcher's control (Theofanidis & Fountouki, 2018). My study had three limitations that are worth expounding:

1. My study was limited to the automotive industry. Future researchers can conduct a similar study targeting other industries such as: (a) retail, (b) hospitality, (c) healthcare, and (d) financial sectors. Additionally, future studies could extend to other automotive countries like Germany, China, etc.
2. While I used a qualitative research method for this study, conducting a quantitative method to examine purchasing managers' strategies for managing material costs could yield exciting findings.
3. The role of information technology will shape the future of supply chain management because competition is no longer about firms but between entire supply chains. George et al. (2019) stated that applying big data, AI, or multidimensional data sources to make rapid adaptive decisions to identify, assess, mitigate, and monitor unplanned events can be the differentiation factor in supply chain management. All participants agreed that IT had simplified their process and improved communication throughout the supply chain network. Therefore, I recommend further studies on how purchasing managers can use information technology to manage material costs.

Reflections

Starting my doctoral journey was one decision I procrastinated on for some time, but I eventually started it precipitously. My purpose in pursuing a doctoral degree was to prepare me for senior management roles in my current organization and improve my writing and critical thinking skills. I didn't understand the rigor, discipline, isolation, and time required to achieve my goal. The requirements of Walden University in conducting this study, particularly the IRB process, served to bolster credibility and strict guidelines to follow. Nevertheless, the program has made me a better person in terms of time management, goal setting, scholarly writing, and critical thinking skills.

Conducting this study has expanded my understanding and knowledge of automotive purchasing managers' strategies for managing material costs. The data collection process allowed me to listen and learn from the collective experiences of senior executives in the field of purchasing. It was instructive for me to understand how purchasing managers look at a cent increase in material price and how they formulate and implement strategies to mitigate price volatility.

Conclusion

The objective of this multiple case study was to explore the strategies that purchasing managers use for managing material costs. I used RDT conceptual framework as a lens to understand the phenomenon. Participants in this study comprised four purchasing managers in the automotive industry who have been in management roles for at least five years. I collected data by reviewing company documentation and conducting semistructured interviews through Zoom. After that, I performed a member checking

process to ensure that I accurately captured participants' responses. In analyzing the data, I used Yin's five-step process of compiling, disassembling, reassembling, interpreting, and concluding.

After completing the coding and analysis phase, five themes emerged, including (a) negotiation, (b) total cost of ownership, (c) reducing design complexity, (d) supplier strategic relationship, and (e) role of information technology. Purchasing leaders may use the findings of this study to develop their own strategies for managing material costs. Effective use of purchasing strategies in organizations could save costs and improve profitability. The research implications for positive social change include developing sustainable partnerships with local companies that will help create jobs for residents of the area and support local social programs.

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Appendix A: Interview Protocol

INTERVIEW PROTOCOL		
Virtual Interview _____		
Recording Devices _____		
Face to Face Interview _____		
Location _____		
Participant _____		
Organization _____		
Date _____		
Purpose	Script	
Opening Statement	<p>Hello, Goodmorning/afternoon. I want to thank you for the opportunity to speak with you today and for your willingness to participate in my doctoral research. Before we continue, I would like to go over some information related to the research with you. The information that I will review with you are;</p> <ul style="list-style-type: none"> Background of the study Study's procedure The benefits and risks of participant involvement Option to continue or withdraw Data and information privacy Member checking process Any questions or concerns <p>Background of the study: The purpose of this qualitative study is to explore the strategies that purchasing executives use for managing material costs. As you know, the future prospects of both existing and new mobility services in the automotive industry will be dependent on production costs. An analysis of the production cost in the automobile industry showed that material cost accounts for more than 50% of the total cost of production, and a reduction in</p>	

	<p>material costs could increase companies' economic viability.</p> <p>Study's Procedure: This interview session will take about 30mins. I will be recording the session for transcription purposes and to ensure that I capture the information accurately. If you need a break during the interview, please let me know, and I will pause the recording. The information in the recording will be stored safely and securely. In addition to the interview information, you may also give me documents to support your statements or documents that contain additional information.</p> <p>Benefits and Risks: The benefit of engaging in this study involves being a part of a study that will provide material cost management strategies for small businesses in the local area to strive and provide local jobs for residents in the area. Conversely, the risk in participating in this study involves divulging proprietary or company-specific information.</p> <p>Option to withdraw: If you feel uncomfortable at any point of this interview, you may withdraw or decline to answer any questions. The recordings and documents will be destroyed or returned to you. This interview is voluntary, and you have the right to decline at any point in the process.</p> <p>Member checking: Please note that I will be returning to review the summary of your responses to confirm that I captured them accurately. At that point, you may make additions, corrections, or subtractions as you deem fit.</p> <p>Privacy: I will not use your personal for any other purpose, and the outcome of this study will not share participant's information or identities. Further details such as the organization's name or location will also not be shared. The data and documents obtained from this process will be stored using a two-step authentication process for five years as required by the university. After five years, I will destroy the data and the documents.</p> <p>If there are no questions at this time, I will begin the audio recording now.</p>	
State the research question	What strategies do purchasing managers use for managing material costs?	
Begin interview session	What strategies are you currently using to manage material costs?	

<p>Ask any additional questions to follow up on key themes identified</p>	<p>How did you assess the effectiveness of the strategies?</p> <p>How have your material purchasing strategies evolved?</p> <p>What tools or resources were necessary for effective material cost management?</p> <p>What strategies did you adopt to identify and develop sustainable supplier partnerships?</p> <p>What, if any, supplier resistance did you experience while implementing cost management strategies?</p> <p>What additional information would you like to offer on strategies you apply to manage material costs?</p>	
<p>Wrap up interview thanking participant</p> <p>Schedule follow-up member checking interview</p> <p>Stop recording and note the stop time</p>	<p>We have come to the end of this interview. Thank you for your time today. I am grateful for the candid responses that you provided and shared with me.</p> <p>May we schedule another session to review how I captured your responses? The next session will only take about 10 minutes.</p> <p>In the meantime, if you think of any other information or questions, please feel free to contact me either through email or phone. My contact details are: Email: obundah.wenah@waldenu.edu Phone: 248-943-6729</p>	