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Smart Technology Adoption's Impact on the Value of Logistics Service Providers' Firms

Raziel Bravo

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Smart Technology Adoption's Impact on the Value of Logistics Service Providers' Firms

by

Raziel Bravo

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

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ACCEPTANCE

This dissertation was prepared under the direction of the *RAZIEL BRAVO* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

Richard Phillips, Dean

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DEDICATION

Despite having lost theirs, I dedicate this research to those who continue to influence my life. Firstly, to my late father, Mario Bravo, who believed in me more than I believed in myself. With utmost pride, I will carry on his legacy of serving others who have less, and the value of success, always remembering that *your best competition is yourself.*

This accomplishment is for my late grandparents, Dr. Anselmo Gonzalez, whose passion for writing and continuous learning prompted my continuous desire to learn, and his wife, Lilia, an epitome of female strength. I pray that I pass on their legacies to my brothers and sisters, that they may also be inspired to reach greater heights and the quest to succeed in life.

To my family – the rock I stand on to reach my goals and the rubber that pulls me back whenever I get lost. To the many people who have been a part of this journey we call life. As I continue with mine while following the path that God has and will lead.

Two roads diverged in a yellow wood,
And sorry I could not travel both.
I took the one less traveled by,
And that has made all the difference.
- Robert Frost

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The three years leading up to this have been a windy road. It would not have come to this point had it not been for the relationships built with my DBA 2023 cohorts. Some of the smartest men and women I have met, also have the heart to pull me back every time I was amut to give up. I will remember how you individually contributed to this journey. The friendships we developed during this program… priceless.

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To my industry colleagues, the practitioners whom I met at one point or another, somewhere around the world, providing that it is getting smaller and smaller each day, particularly to those who participated in this research– and even those who intended to participate, for the valuable time you spared and the insights you shared for me to complete this research. I to achieve the goal of bridging the gap between research and practice in our industry with your continuous help and support.

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ABSTRACT

Smart Technology Adoption's Impact on the Value of Logistics Service Providers' Firms

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Although it took a pandemic to raise awareness about supply chain issues in the minds of the public at large, industry players have long understood supply chain complexities—particularly in the face of continually evolving technologies and ever-more interconnected global enterprises. With Logistics 4.0 and the rapid developments in smart technologies, these complexities make the ongoing need for technology adoption even more complicated for logistics providers. While the literature regularly reports on the adoption of specific technologies, there is little research on the adoption process and even less that might guide providers in prioritizing their technology targets. This research examined the literature for drivers and consequences of technology adoption among providers, then tested those concepts through in-depth interviews with 40 senior-level executives at global logistics provider firms. Among the study's findings are that the drivers and consequences of smart technology adoption are similar among logistics providers. However, firm size, business tenure, and client relationships moderate the adoption of these innovations. The study identifies incumbent people, processes, and systems as "excess baggage" that slows adoption because of adjustments needed to accommodate new technologies and creates bottlenecks for these firms. However, when combined with new competencies, streamlined processes, and proper change management, this baggage may

improve firm performance because of the legacy processes integrated with customers' supply chains. The study also developed a framework to inform practitioners' adoption efforts. The framework addresses the research questions. It also recommends that to realize quicker revenue gains when adopting smart technology. Providers focus on two key drivers: customer relationships and market demands. This research also suggests that providers adopting smart technology leverage their incumbent human resources, processes, and technologies to deliver customer value and improve firm performance.

INDEX WORDS: Logistics Service Providers, Smart Technology, Logistics 4.0, Supply Chain Management

I CHAPTER 1 INTRODUCTION

It's a world of laughter,
A world of tears
It's a world of hope
And a world of fears

When the Sherman brothers, Richard and Robert, wrote the song "*It's a Small World After All"* for Walt Disney in 1962, it was intended to accompany the magical attraction under construction at Disneyland. The ride was built on themes of peace and bringing people together during the Cuban Missile Crisis (*It's a Small World - Wikipedia*, n.d.). It is hard to imagine that the brothers expected that ride—which signified international unity and featured audio-animatronic dolls in traditional costumes from cultures worldwide—to resonate strongly in today's globalized business environment.

Fast forward to 2020—almost 60 years after the song's completion—and the world once again proved how small it can be as a global pandemic paralyzed international trade. At that time, the impact of a globalized society was deeply felt across all borders by people of different genders, ages, and races from all walks of life. The shortage of goods on grocery store shelves and the inability of consumers to simply walk into retail shops and restaurants created uncertainty for people in countries across the planet. The physical shutdown of businesses that relied solely on the world wide web for communications and business transactions created a world of fear—and the culprit? The *supply chain*. The term "supply chain issues" became a buzz phrase, and people began to realize the chain reaction of logistical chaos worldwide.

The evolution of supply chains in the contemporary business setting is a physical manifestation of the cliché that *the world is getting smaller.* Despite the benefit of having a world of laughter—represented by the availability of cheaper goods, versatile choices, various sources, and flexible delivery options—the pandemic made the public realize that it was also a

world of tears. People who were typically not directly involved in supply chain and logistical processes suddenly understood the relevance, challenges, and bottlenecks of supply chain and logistics in the business environment and their day-to-day existence.

While all this is true, it also creates a world of hope. Many people now understand the existence of processes that facilitate the movement of goods to reach stores, places of work, residences, and almost anywhere else that a consumer needs something delivered. The internet promulgated the expansion of firms to a global market and allowed businesses of all sizes to penetrate remote areas. Firms today can choose from a wide range of geographies to distribute their manufactured goods. The web market opened exponential growth in global transactions, allowing customers to purchase products from anywhere worldwide through computer applications or with one click of a button on mobile devices.

I.1 Background and Problem Statement

Raw material sourcing to produce goods may be cheaper in countries outside manufacturing countries and can thus ensure competitive pricing and higher profitability. Manufacturers can even produce components in various parts of the world, then assemble the finished product closer to distribution. This new process of moving goods from sourcing, manufacturing, production, assembly, and distribution of finished products are the logistical parts of the supply chain. They are typically referred to as *upstream* and *downstream* processes.

What used to be simple intertwined processes now include factors that add complexities to the "chain." Human and natural disruptions, for example, can create a bottleneck of issues that clog the supply chain, as evidenced during the recent pandemic. This natural phenomenon created a ripple effect of multiple disruptions that clogged supply chains worldwide.

Firms often focus on their core businesses when they lack the resources and experience to manage the physical movement of their goods (Kawa, 2012) in the supply chain. Logistics is also considered a cost center for these businesses, thus requiring them to outsource these processes to logistics providers. Because customers typically call on these providers to perform services that add more value to their operations (Marchet et al., 2017), providers must ensure that their logistics solutions deliver efficiency and effectiveness for their customers (Oleskow-Szlapka et al., 2018). Through extensive and interconnected processes, logistics providers become extensions of companies' supply chain functions.

The multiple nomenclatures for these outsourced services—including third-party and fourth-party logistics providers (3PL and 4PL providers), logistics service providers (LSPs), and lead logistics providers (LLPs)—create a complex classification of companies that handle logistical processes for firms.

Outsourcing services to logistics providers began in the 1980s and has since matured into a highly reliable option for various supply chain processes. Providers help plan, implement, and control efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption (Stefansson, 2006). Logistics providers offer these multi-faceted services to physically move goods using strategies that address customer expectations while maintaining profitability and market competitiveness (M.-C. Tsai et al., 2008). Companies that once operated their logistics network began to outsource part or all functions to logistics providers, who offer expertise in various solutions, including logistics systems, transportation, warehousing, freight consolidation, distribution, inventory management, and logistics information systems (Kim et al., 2008). This network-

enabled process of handling goods involves multiple actors and intermediaries in an intertwined process (Ceniga & Sukalova, 2015).

With the evolution and inclusion of information systems and technology-supported processes, outsourced logistics, commonly known as 3PL, is now defined in literature as

> *"A strategic technological direction that integrates different types of technologies to increase both the efficiency and effectiveness of the supply chain, shifting the focus of the organizations to value chains, maximizing the value delivered to the consumers as well as the customers by raising the levels of competitiveness. Providers aim to achieve by increasing levels of transparency and decentralization among different parties through digitalization" (Ezzat et al., 2019).*

Previously, the Council of Supply Chain Management, a global association established in the U.S. in 1963, defined logistics process management as

> *"… a kind of programming, implementing and controlling processes, dealing with the flow from primitive occurring point to the final consumption point, and the storage efficiency, as well as the cost-benefit of raw material, half-finished product, finished product, and related information, to satisfy the customer's requirement" (Lin, 2008).*

Today, logistics has evolved beyond simply implementing and controlling processes. The globalization of supply processes has increased the complexity of modern supply chains, which in turn requires logistics providers to become more innovative to meet customers' needs confronted with increasingly dynamic markets (Busse & Marcus Wallenburg, 2011).

The new millennium has opened doors to further development and automation in Industry 4.0. Started in Germany in 2011, the Industry 4.0 concept leveraged the advancement of technology through the Internet of Things (IoT) and Big Data to promote production efficiencies (DOUAIOUI et al., 2018). Technology enables logistics activities that drive transportation and distribution, inventory management, material handling, and information flow, which describes the current Logistics 4.0 environment (Bigliardi et al., 2021). Also known as *smart logistics* or

intelligent logistics, Logistics 4.0 offers a more efficient way to plan, manage, and control activities using technology (Feng & Ye, 2021).

In the technology-driven era of the 21st century, new kinds of technologies are emerging with each passing day. The speed of this evolution makes it imperative for logistics providers to adopt new systems and technologies while consistently updating the incumbent processes they enable. The smart technology concept is one of the latest developments bringing about revolutionary changes in diverse industries and sectors.

I.1.1 Defining Smart Technology

Smart technology can be defined as the use of advanced technologies—including data science technologies such as artificial intelligence (AI), machine learning, and Big Data—that establish in technology a cognitive awareness of an object (Chung, 2021). Smart technology also includes information and communication technologies such as the IoT and blockchain, which play a cardinal role in influencing how technology is used for varying purposes. Saunila et al. defined *smart technology* as technology that derives utility from the functional associations it maintains, along with the potential benefits arising from the fusion of software and software components and mixing content across infrastructures, platforms, and production systems (Saunila et al., 2019).

Initially, the term smart technology was used to generalize the concept of "smart structures" and primarily involved mechanical systems using actuators, sensors, and pre-programmed controllers that let the structure adapt to uncertain and unpredictable external factors (Holnicki-Szulc et al., 2008). Smart technology also refers to the application of any technology that would facilitate the enhancement of a user's natural capabilities. However, technology has come a long way and undergone major changes leading to its rapid advancement

and application in diverse areas. The smart technology term gained momentum in this process, particularly when companies began integrating automated elements.

The definition and scope of smart technology have become broader due to technological advancements. At present, smart technology refers to the right combination of technologies enabling seamless connectivity between people, devices, ecosystems, and infrastructures. It fundamentally involves integrating data and information in real-time and optimizing technology's core features (Thukral, 2019). Smart technology's definition keeps changing and evolving depending on the technologies that are integrated into it. However, in recent years, the scope of it has widened to include innovative technology solutions such as AI, machine learning, and Big Data. The availability of a huge volume of data and information in the digitalized era has magnified the capabilities of smart technologies and led to its popularity and usage in practical settings (Akhilesh, 2020).

I.1.2 Smart Technology in Logistics

Smart technology emerged as a necessary support to the current upstream and downstream supply chain processes typically outsourced to logistics providers for firms to maintain their competitive edge in the market. While smart technologies substitute some human aspects in the logistics industry, the industry needs a combination of cyber-physical systems. As one leading logistician wrote, "the quality of a 3PL comes down to three main things—*people, process and IT*" (*Tech's Importance in Communication - by Dave Ross*, n.d.).

In logistics, these technologies facilitated upstream and downstream logistic services' capacity and efficiency by applying emerging intelligent information technologies (Feng & Ye, 2021). It has augmented older technologies, such as the use of Electronic Data Interchange

(EDI), since the 1990s to combat the uncertainties arising from added complexities in logistics processes (Sheffi, 1990).

I.2 Purpose Statement

Given the cost of technology, the continuous adoption of new processes, the human resource skills required to manage and implement its utilization, and the technology integration required, modern supply chains require considerable investment for logistics providers. This statement is particularly true for firms that existed long enough to experience rapid smart technology growth in the new millennium. These firms face requirements that trigger the adoption of new developments to address evolving market and customer demands and the continuous updating of antiquated technological processes already in place. They also must make these transitions without interrupting current processes to make them seamless for external parties in the network.

When processes are heavily integrated with customers, logistics providers typically request that customers collaborate through systems enhancement or installing new technologies for mutual benefit for both parties. This process develops value co-creation between parties and strengthens customer and provider relationships. Smart technologies enable data integration in the interconnected network of supply chain participants. However, despite its advantages to the supply chain actors' firms, the network does not need to support the adoption costs. Typically, logistics providers bear the cost of technology and its adoption. So, while some customers cover the cost of some technology, it still impacts providers' incumbent human resources, processes, and current technologies, and any change or adjustment in these entails additional costs. The provider's incumbent processes are considered *excess baggage* in their smart technology adoption.

Organizational limitations in human capital, infrastructure, and financial constraints are critical to determining which technology to prioritize. The ubiquity of technologies in the market today is another dilemma for logistics providers. Its adoption requires resources and time, which are luxuries that most businesses do not have. On top of financial investments, new processes require a firm's human resources to adjust current skill sets or learn new ones, which creates disruptions and constraints in current business operations. Furthermore, despite these constraints, the speed of technological innovation can surpass the time required for its implementation. Also, new competition in the form of industry disruptors comes with the emergence of newer smart technologies in the logistics marketplace. Firms must expand their service offerings and capture market share to retain competitiveness.

I.3 Nature of the Study and Research Question

To succeed, logistics providers must keep up with all of these demands. Technology investments seldom immediately impact provider firms or increase their internal value to stakeholders. Customers are the main beneficiary of this technology adoption, and the goal of being a stiff competitor on both price and services in the market does not always equate to higher financial returns for providers. It is a dilemma that creates a complex problem in real-world business problems. To manage the dilemma, providers must be intentional in their smart technology adoption process

Given the topic's novelty in academia, the literature is limited to the utilization and impact of smart-technology-enabled systems on logistics providers and the efficiencies these technologies contribute to firm performance. Literature examples include the use of wireless networks and 5G mobile communication (Dong, 2021), smart logistics eco-systems (W. Liu, Liang, et al., 2021), AI in last-mile delivery (Sorooshian et al., 2022), blockchain in urban

logistics (Tian et al., 2021), and eCommerce mobile platforms. The literature has yet to widely assess providers' smart technology adoption and its impact on the value of their firms. Given that various types of providers offer many services, most of the studies focus on smart-technology-enabled systems and applications for specific services. My aim in this research is to broaden the research perspective to encompass the impact of smart technology adoption in general—rather than of adopting a specific technology—to cover all types of providers offering various types of services.

Through this qualitative research, I gathered insights from 40 LSPs globally to identify factors that drive smart technology adoption and constructs to determine its consequences on people (human resources) and processes. I used a thematic analysis to extract common ideas or themes from industry practitioners, all of whom hold positions with decision-making ability or influence in their respective firms' smart technology adoption. Using thematic analysis provides an in-depth, socio-contextual, and detailed description of the research topic to interpret the context phenomenon (Vaismoradi et al., 2016). In my study, themes emerged through deep analytical analysis and interpretation of data gathered through field research with global logistics providers. My findings and results, which validated concepts in prior literature, were aimed at addressing two research questions:

What factors should logistics providers consider during smart technology adoption to increase their firm's value despite resource constraints (RQ1)?

What are the nonfinancial benefits of smart technology adoption for logistics providers? (RQ2)

I.4 Assumptions

I anticipated overlaps between preliminary concepts identified in the literature and themes synthesized from the data gathered during the field interviews using an inductive analysis method. I assume that combining key elements in theoretical research and practitioner experiences creates rigor and relevance to address these research questions.

My findings present a framework to guide practitioners in prioritizing smart technology investments to gain better financial impact for their logistics providers' firms. Given the stiff competition in this industry and the constant pressure from changing market conditions, technology adoption is critical for these businesses to retain their competitive edge.

In addition, I contribute to the literature by expanding on the benefits of smart technology adoption from a broader perspective rather than a focus on specific technologies (such as AI, blockchain, or IoT). My study focuses on logistics providers, but it could be replicated among its customers, intermediaries, and actors in the supply chain network.

II CHAPTER 2 LITERATURE REVIEW

II.1 Selection Process of Review Literature

Smart technologies benefit organizations in general. In this study, I considered studies on specific technologies in prior research to develop a theoretical framework for providers. Although it is a novel academic topic, researchers have identified some key issues. Among them is that logistics providers vary in size, and not all have equal opportunities to enhance their systems through modern technology (Kawa, 2012). Furthermore, these smart logistics operating systems require competencies among a firm's people and investments in infrastructure (Kawa et al., 2010).

The transformation of services to support smart logistics entails considerable investments, and covering those investments requires collaboration between the logistics provider and its customers (W. Liu, Long, et al., 2021). When providers adopt technologies, they typically expect them to address customer needs. However, most providers have a long list of customers with varying requirements. Given these distinct customer requirements, adopting new technologies can result in a performance surplus that some customers are unwilling to pay for. So, in effect, these investments do not guarantee additional revenue that might increase the firm's value. Further, customers might easily assume that the technology's adoption is for the sole benefit of the provider, such as to support logistical demands due to changing trends in supply chains and other provider-specific challenges.

However, adopting smart technology is necessary to support logistics providers' upstream and downstream processes to provide value to their customers while maintaining their competitive advantage. Other factors in this process impact firms and may not be favorable to them in the near term. With the emergence of newer technologies and enhancement of existing

technologies in the market, the literature focuses on smart-technology-enabled systems' impact on specific logistics services, not on its adoption and impact on the logistics firms themselves.

My exploration of this topic was rooted in an integrative approach to reviewing and synthesizing prior literature to create a framework for logistics providers' smart technology adoption. As Snyder (Snyder, 2019) posits, using the rigor of literature to synthesize the effects is an effective approach to designing a conceptual framework. Connecting, explicating, and debating existing ideas in literature combined with new ideas emerging in the research is useful in conceptualizing research concepts. These ideas are also useful in conducting a thematic analysis to categorize commonalities according to implicit usage or in an interpretation to narrow down concepts in the literature (Vaismoradi et al., 2016).

The literature on smart technology adoption includes considerable jargon. To locate relevant literature and identify interconnections among authors of articles about or related to the topic (Noruzi, 2005) of logistics providers' smart technology adoption, I used Google search to filter materials and identify the topic's main concepts and other keywords with similar meanings to create semantic connections (Siddiqi & Sharan, 2015). This process aided the translation of natural language terms used in practice and their academic counterparts.

II.2 Logistics Outsourcing and Smart Technology: A Brief History

To understand emerging factors, I examined the historical perspective of logistics outsourcing—which the literature posits existed before the evolution of logistics technology—as well as the history of smart technology. I also scoured the literature to locate historical factors in providers' technology adoption.

II.2.1 The Roots of Logistics Outsourcing

The origin and evolution of the logistics service industry—commonly known as *logistics outsourcing*—is critical to understanding the issues that emerged over the past several decades. A vast amount of literature on logistics outsourcing and service providers has evolved based on the stages of its development. Outsourcing has since become an established practice in which firms contract out logistics management activities that were previously executed in-house (Bolumole et al., 2022). One definition states that logistics outsourcing occurs when an external vendor provides one or more logistical services for a specific period (Razzaque & Sheng C.C., 1998). Outsourcing a firm's logistics activities was previously known as *third-party logistics*, and providers of these services were referred to as *3PLs* (Selviaridis, 2016) or *TPLs* (Premkumar et al., 2021). While service providers do not own the products for distribution, they are responsible for performing required logistics activities for the logistics providers' customers, which is the company purchasing or delivering products (Papadopoulou & Macbeth, 1998). To maintain their competitiveness, providers must adopt best practices and innovations to improve their performance and customers' supply chains (Panayides & So, 2005) while maintaining profitability.

Scholars associate the evolution of the logistics industry with shifts in manufacturing processes, typically driven by stages of the industrial revolution (Ezzat et al., 2019; Hu, 2013; Oleskow-Szlapka et al., 2018). The discovery of the steam engine in the second half of the 17th century revolutionized machine transportation in Industry 1.0. During this period, the practice of moving goods using machinery—now known as *logistics*—had not yet been associated with an official term. In 1898, the term "logistique" was introduced in France for planning and moving military troops as a war strategy (Galindo, 2016). Production and manufacturing were mainly sourced domestically in the second industrial revolution from the 19th to the 20th centuries.

During this period, firms managed their logistics activities, while logistics providers focused only on physical and haulage services (Ezzat et al., 2019).

The end of World War II was marked by market upheaval. Businesses focused on operational efficiency characterized by quick response times and new market service improvements (Papadoupolou et al., 1998). The demand for speed and efficiency prompted mass production in the 1960s, providing low-cost, high-scale manufacturing that allowed firms to expand to different geographies (Hu, 2013). Containerized transport was introduced as part of modernization and mechanization in 1956 (Poli et al., 2018), and the advancement in electronics and information technology (IT) developed production processes in the 1970s. Companies have since started considering the value of outsourcing other logistics processes (Saw, 2012). Modernization is the evolution of technology in Industry 3.0 (Bigliardi et al., 2021)), which gave rise to the development of concepts such as *Just in Time*, which brought production to a higher level by providing quick responses and efficiencies by combining engineering concepts with information technology (Poli et al., 2018). For firms to focus on their core competency, logistics providers started offering services beyond transportation in the 1980s, and they have since matured into a highly reliable option for various supply chain processes. Companies that once operated their own logistics networks began to outsource parts or all of their logistic functions to providers who offered expertise in various solutions, including logistics systems, transportation, warehousing, freight consolidation, distribution, inventory management, and logistics information systems (Kim et al., 2008).

II.2.2 The Rise of Smart Logistics

The development of smart technology intended to support logistics processes created a hybrid approach that exploited interdependencies between technological implementation and

human capabilities (Cimini et al., 2020a); this facilitated upstream and downstream logistic services' capacity and efficiency by applying emerging intelligent information technologies (Feng & Ye, 2021).

A distinguishing feature of smart technology is that it uses a plethora of innovative and digital elements such as sensors, algorithms, and data (Seidel & Berente, 2020). A common example of smart technology today is intelligent AI-driven personal assistants, such as Apple's Siri and Amazon's Alexa. Smart technologies are believed to be one of the most promising inventions of current times, with the potential to alter and redefine the face of technology. Many researchers believe smart technologies will offer innovative solutions for addressing various challenges in our globalized era (Vinogradova et al., 2021). The adoption of smart technology is thus viewed as transformative for various industries, including healthcare, retail, manufacturing, and education (Akhilesh, 2020).

Initially, the term *smart technologies* was used to generalize the concept of "smart structures." These structures involved mechanical systems made using actuators, sensors, and pre-programmed controllers that let the structure adapt to uncertain and unpredictable external factors (Holnicki-Szulc et al., 2008). Smart technology was also used to refer to the application of any technology that would facilitate the enhancement of a user's natural capabilities. The definition of smart technology continues to change and evolve depending on the technologies integrated into the technology. In recent years, its scope has widened to include innovative technology solutions such as Big Data, AI, and machine learning. The availability of an enormous volume of data and information in the digitalized era has magnified the capabilities of smart technologies and led to their popularity and usage in practical settings (Akhilesh, 2020).

In the new millennium, providers began considering ways to improve their services to meet rising customer expectations by leveraging IT to facilitate the physical flow of goods (Premkumar et al., 2021). The adoption of technology in production and manufacturing prompted the development of Industry 4.0, which triggered the need for speed, magnitude, and depth in the production and delivery of manufacturing goods to keep up with the increase in consumer demands. To meet this rapid shift in demand, companies required external support to adopt process changes (Barreto et al., 2017). The pressing need for technology to enable flexibility, agility, and efficiency led to Logistics 4.0. Technological systems and tools such as the IoT, Big Data, analytics, and virtual technology have supported service providers in accommodating these new customer demands (Tiwong et al., 2020).

The strategic direction of Logistics 4.0 required logistics providers to adopt technologies that provide customized products and services while also enabling them to recognize situations occurring throughout the supply chain sensitively and to respond to them quickly through analysis and forecasting (G.-S. Cho, 2018). Logistics 4.0, therefore, triggered the development of *smart logistics*—that is, technologies that support the increasing demands of global supply chains and current transportation systems by providing cost-effective services that deliver safe, durable, and timely products to the customer anytime and anywhere (DOUAIOUI et al., 2018).

The literature does not offer a common definition for Logistics 4.0. Based on its history and evolution, Ezzat et al. (2019) offered the closest thing to a shared definition of Logistics 4.0 and characterized different logistics eras in Figure 1:

"a strategic technological direction that integrates different types of technologies to increase both the efficiency and effectiveness of the supply chain, shifting the focus of the organizations to value chains, maximizing the value delivered to the consumers as well as the customers by raising the levels of competitiveness achieved by increasing the levels of transparency and decentralization among different parties through digitalization."

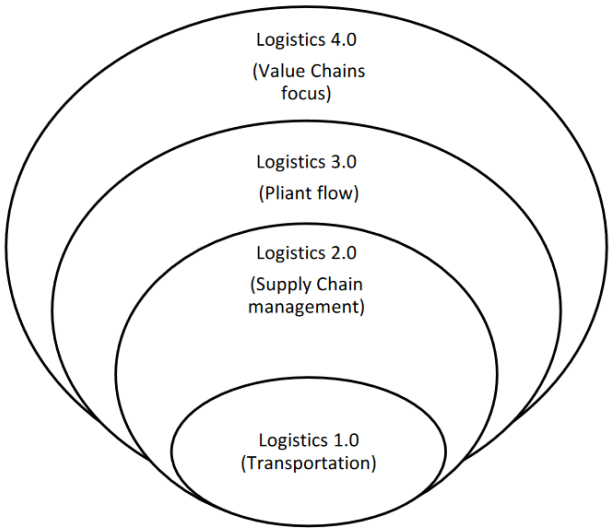

Figure 1 Relationship between logistics eras (Ezzat et al., 2019)

The historical perspective of logistics outsourcing implies that providers evolved from the time that they existed in the market. While smart technology adoption is more recent, we aim to determine if technology outpaced their firms' evolution. Literature posit that to ensure their firms' existence, they must continue to adopt technologies and the impact of these technologies on their firms.

Supply chain management is essential for business entities to effectively and efficiently deliver value for their target market. Adopting new technologies helps them develop supply chain network capabilities that support this aim. New technologies help businesses streamline their work processes and boost their capabilities in the supply chain networks by boosting their digital capabilities (Nasiri et al., 2020). In this research, I identified drivers and consequences of smart technologies in logistics and their implications for providers' firms.

II.3 Smart Technology Adoption Drivers: Internal Factors

II.3.1 Competitive Advantage

Today, using technology to support physical services is considered a competitive advantage for logistics providers (Sohn et al., 2017). Providers continue to innovate to improve their performance measures (Hazen & Byrd, 2012) and develop and provide the knowledge and technological skills their customers do not have (Marchet et al., 2017). This process requires providers to develop familiarity with their customers' businesses and expectations to address the key aspects of outsourced services that can support the customer supply chain.

This mutual relationship cultivates a long-term partnership between the customer and their provider. Hence, customer firms often refer to their logistics providers as *supply chain partners*.

New technological innovations often track and manage their performance based on customer expectations and performance indicators.

II.3.2 Customer Value

A company's supply chain—that is, its packaging, inventory, storage, and transportation—includes all parties, from sellers to manufacturers to points of sale (Helo & Shamsuzzoha, 2020). Providers manage these processes for their customers. A customer firm's financial performance and long-term viability depend on adopting a distribution management plan. They need a good distribution administration system to maintain customer satisfaction and competitiveness. Real-time inventory tracking allows businesses to ensure they have the proper on-site items to satisfy client demand (Paul et al., 2019).

Smart technology gives logistic providers greater insight into the activities allowing them to recognize and act to solve problems (Ralston & Blackhurst, 2020). Greater automation helps

businesses handle their distribution systems more successfully. There are essentially two forms of distribution: physical distribution (logistics) and commercial distribution (Rodrigue, 2020). Among the roles involved in distribution activities are client relations, transportation, storage, inventory management, private transportation fleet activities, packing, collecting, materials transportation, plant, storage facility, and store site planning and data coordination (Straka, 2019). With the emergence

II.3.3 Process Transformation

AI in upstream activities has strengthened the planning estimation and purchase processes. By leveraging AI, companies across diverse industries streamline upstream activities and make supply chain operations more resilient and optimized (Atwani et al., 2022. Companies are using machine intelligence to explore near-optimal solutions to complex challenges such as routing issues and the optimization of warehouse transportation (Riahi et al., 2021) and using machine-learning-based predictive analytics to make smart vendor-related decisions and carry out processes in a cost-effective way.

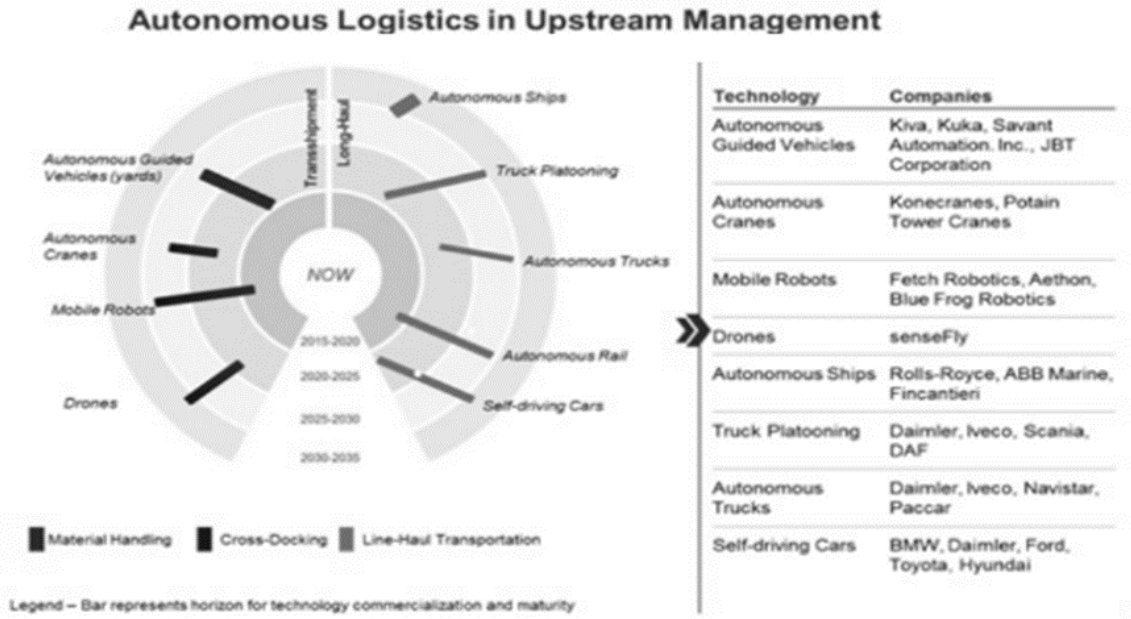

Figure 2 Autonomous logistics in upstream management (Gromovs & Lammi, 2017)

Smart technologies have made their presence felt in the downstream operations and processes businesses carry out to deliver finished products to the market (Hunaid et al., 2020. Some of the chief smart technologies that have increased the efficiency of downstream activities are automation, remote operations monitoring, and smart assembly (Markov & Vitliemov, 2020). The figure below shows the major enabling smart technologies that firms adopt to transform their downstream operations.

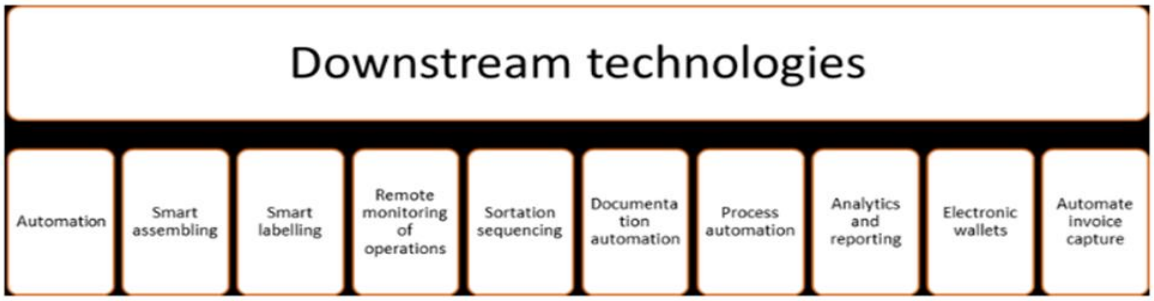

Figure 3 Downstream technologies (Bvepfepfe et al., 2019)

II.4 Smart Technology Adoption Drivers: External

II.4.1 Market Demands

Technology adoption in manufacturing triggered the need for speed, magnitude, and depth in producing and delivering goods to keep up with the change in consumer demands. In the new millennium, providers began considering ways to improve their services to meet rising customer expectations by leveraging IT to facilitate the physical flow of goods (Premkumar et al., 2021).

The era of eCommerce and digitalization has significantly accelerated the complexity associated with warehousing. For example, a major hassle for eCommerce retailers is to assemble a large volume of products and commodities on time and respond to the specific needs of their buyers (Boysen et al., 2019). eCommerce is very different from conventional business; in the online business setting, it involves acquiring products, analyzing them, and sending orders to clients. The transaction begins when a consumer places an order and finishes when they receive it. If a customer decides to send something back, the order fulfillment system also must handle the return. The increasing demand for eCommerce in the globalized times has increased the reliance on smart technologies to optimize supply chain operations, including warehousing activities so that digital businesses can be well equipped to operate in the modern business setting. In such a challenging and unpredictable business landscape, smart technologies have strategically automated diverse activities and processes (X. Liu et al., 2010).

II.4.2 Technological Advancements

The beginning of the 21st century prompted the creation of more modern facilities and infrastructure, including logistics parks, distribution centers, and warehouses (Lin, 2008). These modern physical logistics spaces necessitated operational mobility through technologies such as

order management, transport management, and warehouse management systems (Kim et al., 2008). According to Jarašūnienė et al. (2023), digitization and automation are the key driving forces of modern warehouse management.

Some businesses have integrated AI into their supply chain operations to boost their functionality and performance. Pandian (2019) has argued that implementing AI has boosted the potential of diverse functions such as management, logistics, and coordination (Pandian, 2019).

However, traditional logistics providers still need to evolve with the speed of technology to adopt digital innovation strategies that ensure the required internal performance and the demand-side – market adoption (Mikl, Herold, Ćwiklicki, et al., 2021). At the same time, they also must enhance legacy technologies to avoid being outperformed by other providers and digital start-ups (Hopp et al., 2018)) and to continue providing value to customers.

II.4.3 Increasing Competition

The pressure to pursue digital change is not limited to customers but also comes from employees, business partners, and competition—including the entrance of new competitors in the market (Cichosz et al., 2020). The emergence of asset-free integrators known as fourth-party logistics operators (4PLs), or LLPs, manage and orchestrate the services of other parties, including traditional logistics providers (Fulconis & Paché, 2018). These 4PLs create a new layer of actors between providers and their customers (Schramm et al., 2019).

Further, factors external to the logistics industry created new market dynamics, which resulted in new customer requirements. Among these external factors was the rapid growth of eCommerce, which became a substitute for retailers' brick-and-mortar stores (Bhatti et al., 2020) and increased the demand for speed and visibility. eCommerce also increased demand for last-mile solutions (Borgström et al., 2021). The result was the emergence of fifth-party logistics

(4PL and 5PL); these asset-free integrators manage logistics providers for customers and have created a new layer of actors between providers and their customers (Schramm et al., 2019).

The internet and the proliferation of logistics software have given the logistics industry an unprecedented boost in efficiency and visibility due to rapidly changing market demands, which have opened opportunities for digital start-ups (Mikl, Herold, Ćwiklicki, et al., 2021). In an article published by Wiley and co-authored by the entrepreneur-founder of digital logistics start-up Shipstra, the authors outline how these new types of providers develop digitalized processes based on market demands (Giraldo-Diaz & Fuerst, 2019). The article outlined the development of process digitalization to support customers' logistics processes (Giraldo-Diaz & Fuerst, 2019). This digitalization process is one of the digital disruptions that emerged as a threat to traditional providers in the logistics industry (Hofmann & Osterwalder, 2017).

II.4.4 Supply Chain Disruptions

Supply chain disruption is an unplanned or unanticipated event that disrupts the normal flow of goods and materials within the supply chain (Macdonald, Corsi, 2013). For providers, supply chain disruptions occur regularly in organizations and are more prevalent in companies involving or utilizing global processes. In a typical logistics environment, external factors from the most isolated, singular issue to a global event create a chain reaction of issues affecting one interdependent factor after another. These issues create an impact that might be as isolated as one transactional activity or as broad as an entire logistical process that impacts the organization's supply chain (Bravo et al., 2022).

More recently, the massive disruptions caused by COVID-19 in 2020 created issues in supply chains that required restructuring existing production and sales models (Przhedetskaya et al., 2021), impacting the global logistics processes. Lockdowns created changes in consumer

purchasing patterns that led to a sudden upsurge in eCommerce volumes through multiple marketplaces, platforms, and social media, extending to products not typically procured over the internet (Bhatti et al., 2020). The figure below illustrates a supply chain redesign due to the recent pandemic.

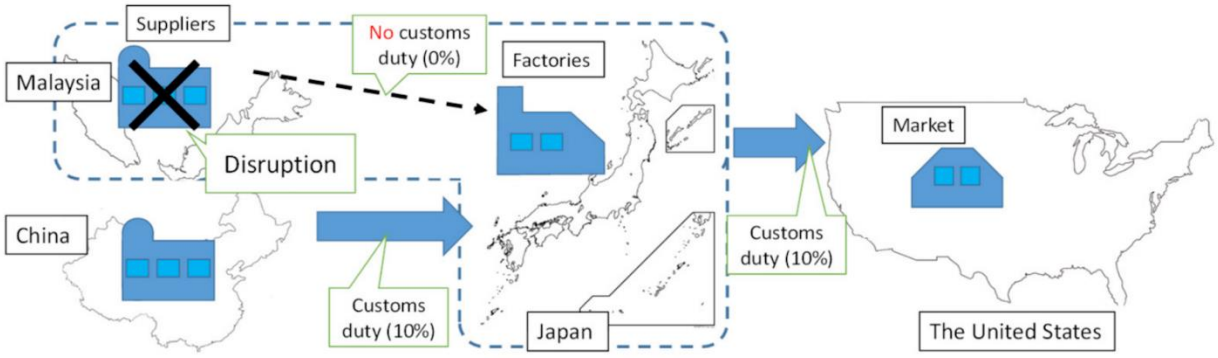

Figure 4 COVID-19 Disruption Strategy for Redesigning Global Supply Chain Network (Nagao, et. al., 2021)

II.5 Consequences: People

II.5.1 Enhanced Quality of Work

Logistics benefitted from technological innovations that impacted human work. Logistics providers play a vital role in physical and cognitive activities through advancedhuman–machine interactions (Cimini et al., 2020a) in customers' supply chain processes. Articles predicted that in this stage of industrialization, technology would eventually take over human aspects of logistics processes (Jafari et al., 2022). In Industry 4.0, minimal attention was paid to smart technology's human and societal aspects (Jafari et al., 2022). Still, companies eventually recognized the importance of the human role and human interaction with technology and considered humans in the broader socio-economic context (Frederico, 2021).

The distribution sector is increasingly using robotics and automation to more accurately and efficiently sort and pack products in warehouses (Jagtap et al., 2020). The newest versions of

warehouse robotics are built to collaborate with workers to create more effective and secure processes (George & George, 2020). In such cases, automation may handle the repetitive, boring duties that employees often avoid.

The use of these technologies extends beyond storage facilities. It supports administrative processes. Robotic process automation (RPA) uses structured data to address rules-based operations automatically and can enhance service to clients, payment, and other duties (Syed et al., 2020). RPA uses computer keystrokes that resemble those made by humans to carry out these routine operations more quickly and accurately. Furthermore, automation lessens the requirements for more labor, which organizations may find difficult to find, hire, and retain to expand and develop the business (Dekhne et al., 2019).

II.5.2 Productivity Improvement

Researchers argue that the emergence of smart technologies has been inducing significant transformation and revolution in logistics and transportation activities (Chung, 2021). Innovative technologies such as IoT and blockchain have shown immense potential. These technologies boost the level of capabilities of existing human resources. They also support the delivery of efficient logistic operations by optimizing current methodologies.

Warehousing is an integral process in the supply chain management function that involves storing physical materials and inventory for sale or distribution in the market. It is one of the key areas that has undergone revolutionary modification as businesses adopt smart technologies. The *smart warehouse management* concept has recently emerged and involves adopting modern technologies to give businesses better control over their stored inventory items. Businesses integrate smart technologies into their warehouses to effectively monitor, control, and track their operations (Mostafa & Hamdy, 2018). In the globalized era, smart technologies

enabled businesses to keep a real-time tab on their warehouse processes and identify any discrepancies or deficiencies in a timely manner (Vinogradova et al., 2021). Researchers cite the IoT as instrumental in empowering warehouse managers by giving them better control over inventory items and allowing them to monitor operations carried out by warehouse workers in real-time (de Vass et al., 2018). Although the concept of the smart warehouse is fairly new at present, it can help businesses boost their levels of warehouse automation and productivity, as well as reduce manual errors that lead to business losses or waste (Jarašūnienė et al., 2023).

The concept of autonomous logistics in upstream management involves the integration of autonomous or remote technologies and relying on manual labor to reduce the possibility of errors or delays (Perdana et al., 2020). A key benefit of adopting autonomous technology in upstream activities is that its capability is not restricted to the warehouse alone, as it can be leveraged for everything from trans-shipment to cross-docking to long-haul transportation (Gromovs & Lammi, 2017). Among the main autonomous logistic components that have created dynamic change in upstream logistics operations are autonomous guided vehicles, autonomous cranes, mobile robots, drones, autonomous ships, autonomous trucks, self-driving cars, and autonomous rails (Wang et al., 2020). Autonomous logistics technologies enable the quality of labor in logistics activities, therefore, improving workforce performance.

II.6 Consequences: Processes

II.6.1 Reduced Process Complexities

The uncertainties arising from added logistics process complexities started with EDI adoption in the 1990s (Sheffi, 1990) to enable effective communication and collaboration among these varied elements. Smart technologies' emergence and rapid development have induced significant transformations in logistics and transportation operations (Chung, 2021). In the 21st

century, the integration of smart technologies has radically changed how businesses carry out and manage diverse activities and processes in the supply chain network (Weiland, 2021).

Organizations operating in diverse industries and sectors are integrating innovative technological solutions into their supply chain networks to reduce complexity. Smart technology is believed to be one of the most promising new digital solutions and one that opens new possibilities for firms to build smart supply chains that are well-equipped for the fourth industrial revolution (Nasiri et al., 2020). Using embedded sensors such as RFID and transportation systems has made the supply chain's delivery management process more systematic and streamlined. While existing technologies such as APIs (or EDIs) and RFID have allowed supply chains to extend internationally by streamlining many business operations, the sector still faces challenges that blockchain technology might solve (Mostafa et al., 2019).

On the other hand, IoT technology in warehouse operations allows businesses to process a large amount of data in real time with maximum efficiency (Rejeb et al., 2019). It enables firms to implement technologies such as smart identifications, tracking and tracing technologies, global positioning systems (GPS), infrared sensors, and laser scanners. Smart technology has upgraded the ability of firms to monitor inventory movement while also optimizing administrative processes (Kumar et al., 2020). IoT technology better positions companies to forecast market demand trends, track the goods in real time, and carry out other warehouse operations. Adopting IoT technology also allows businesses to achieve sustainable development goals. Research has shown that by automating warehouse systems, some companies have improved their sustainability performance in terms of productivity, workforce safety, and reduced air emissions (Aravindaraj & Rajan Chinna, 2022). Firms can use IoT technology to track products that need to reach customers. IoT has eased the complexity associated with the

delivery flow and improved the ability of firms to manage and monitor their delivery process (S. P. Cho & Kim, 2017).

II.6.2 Improved Shipment and Inventory Visibility

The inability to communicate in real time remains a major challenge in the supply chain. A fundamental benefit of integrating smart technology into supply chain operations is that it helps improve efficiency and productivity in managing inventory levels and tracing items within the network (Raj et al., 2022). AI in the supply chain has made it possible for businesses to get timely insights into their core operations and effectively adapt to the evolving market (Pandian, 2019). Adopting IoT allows businesses to track their inventory items in real time (Hussain et al., 2021). Timely insight into the exact status of a shipment can enable the logistics provider to avoid unnecessary delays and improve the professional association with its customers. Logistic providers can use real-time tracking to offer clients accurate delivery times and increase supply chain visibility (Hunaid et al., 2020)

Integrating smart technology has made it possible to seamlessly integrate supply chain operations with logistics processes (de Vass et al., 2018). The adoption of IoT in the upstream activities of the supply chain network has opened up new possibilities because of the intelligence feature. IoT has empowered entities to capture real-time information about inventories and materials (Hussain et al., 2021).

A broad range of participants are involved in the upstream and downstream activities, which increases the complexity of the supply chain network (Alkhatib, 2017; Alkhatib et al., 2015; Kalkha et al., 2023). For example, it is instrumental for businesses to communicate and engage with the supply chain participants at all times to get the latest status of the materials. Blockchain technology ensures that all the participants in the supply chain network have access

to uniform and consistent information. Hence, it eliminates the possibility of ambiguity and promotes collaboration and transparency (Deloitte United States, 2022).

II.6.3 Fostered Better Network Collaboration

The role of technology for logistics providers has evolved from offering a broad array of bundled physical services (Zacharia et al., 2011) to playing an integrative role in linking different supply chain elements more effectively (Evangelista et al., 2013). A broad range of participants are involved in the upstream and downstream activities, which increases the complexity of the supply chain network (Alkhatib, 2017; Alkhatib et al., 2015; Kalkha et al., 2023). Paradigm transitions in modern processes require connectivity and digitization from logistics providers to adapt to changing customer requirements (Oleskow-Szlapka et al., 2018). The industry called for collaborative-physical systems (CPSs) that track the physical and virtual worlds to aid in rapid decision-making (M'hand et al., 2019).

Adopting smart technology in the supply chain network allows logistics providers to conduct real-time information exchanges among diverse participants in the network (Frazzon et al., 2019). Integrating smart technologies into upstream and downstream supply chain activities is essential for firms as they gradually progress toward the Industry 4.0 environment (Kersten et al., 2017). These technologies offer businesses a major advantage and help them strengthen their supply chain foundation and empower all participants in their supply network (Frazzon et al., 2019)

Blockchain technology, for example, ensures that all the participants in the supply chain network have access to uniform and consistent information. Hence, it eliminates the possibility of ambiguity and promotes collaboration and transparency (Deloitte United States, 2022). It has

also simplified a firm's ability to capture and exchange information on a real-time basis and improved the overall effectiveness of the supply chain network (Hussain et al., 2021).

Researchers have argued that adopting smart technologies in the supply chain helps mediate between digital transformation and collaboration (Nasiri et al., 2020). Evidence also shows that businesses are working on their technical capabilities to strengthen their supply chain operations to effectively collaborate with their stakeholders to create value at a holistic level (AlMulhim, 2021).

II.7 Positive Performance Implications

II.7.1 Reduced Operating Costs

Smart technologies use AI, Big Data, and analytics to improve the distribution network. Distribution businesses view the use of smart technologies—which can gather and analyze data on consumer behavior—as the most effective method for shipping and delivering items (Mishra & Tyagi, 2022). To calculate potential demand and manage inventory, logistic providers use AI to examine consumer data, including past purchase behaviors and delivery times (Dash. et al., 2019). Such data allows businesses to streamline distribution processes and minimize time and expenses. In academic and practitioner journals, articles on the smart technology investments of traditional logistics providers focus on their use of technology to improve their operations. These innovations allow them to augment their labor resources and thus retain a competitive advantage by reducing costs, providing innovative and customized services, and improving service quality (Lai et al., 2004). Empirical evidence showed that these technological advancements saved organizational costs (Dekhne et al., 2019).

II.7.2 Provider and Customer Value Co-Creation

For smart logistics transformation to occur effectively, a collaboration between logistics providers and customers is critical (W. Liu, Hou, et al., 2021a). For smart logistics transformation to occur effectively, a collaboration between logistics providers and customers is critical (W. Liu, Liang, et al., 2021). Value co-creation among these parties is required as they interact to support mutual competitive advantages in a collaborative environment (Sinkovics et al., 2018). Technology has been playing a cardinal role in improving the overall efficiency and safety within the supply network. In the eCommerce business landscape, smart technologies simplify the product tracking process and thus enhance the experience of both businesses and their customers (Kalkha et al., 2023).

II.8 Negative Performance Implications

II.8.1 Incurred Training and Adoption Costs

The most recent global disruption allowed businesses to reassess their supply chain activities and explore innovative ideas for business continuity (MacGregor & Vrazalic, 2005) and resilience. It triggered providers to substitute human labor with capital-intensive technologies for operational performance and financial gain. Although integrating smart technology gives rise to new opportunities and possibilities to improve the conventional supply chain process, the cost is a major limitation. The adoption of smart technology needed to facilitate automation requires considerable financial resources. The unavailability of adequate funds can give rise to financial burdens for 3PL providers (Gupta et al., 2019).

Technological developments are advancing the sector and improving the distribution system’s efficiency, cost-effectiveness, and sustainability (Nahr et al., 2021). The latest trends in logistics operations include contactless deliveries and personal shopping services, demand for

more physical services from logistics providers, and increased operational costs (W. Liu, Liang, et al., 2021). Stacks of technologies based on the cloud enable several of these improvements. While smart technologies can help logistic providers increase efficiency and minimize expenses by streamlining their processes and limiting waste. Such technologies also create challenges for logistic providers, such as the expense of implementing these advanced technologies (Benarbia & Kyamakya, 2021). The transformation of services to support smart logistics entails considerable investments; covering those investments requires collaboration between logistics providers and their customers (W. Liu, Long, et al., 2021).

The literature posits that providers cannot assess the actual value of technology adoption and integration costs among other players critical to their service provision. However, they do anticipate cost savings for these initial investments in the long term (Mathauer & Hofmann, 2019). Other research has found that providers absorb these high costs and low returns due to rapid technology changes, systems customization, and customers' refusal to pay for the costs of technological improvements (Wagner & Sutter, 2012)

II.8.2 Cyber Security Threats

As with other technologies, digital innovations entails notable challenges and threats. Adopting smart technology in the supply chain also increases security and privacy concerns (Pandey et al., 2020). As technology is undergoing rapid evolution, cybercriminals can violate the technology used by 3PL providers and compromise the entire supply chain network.

Blockchain improves data safety by exposing specific data to a small group of users and promoting openness among them (Raja Santhi & Muthuswamy, n.d.). Customer emails and other personal information have reportedly been compromised in eCommerce fulfillment and traded online to spammers. To improve data security, last-minute couriers create delivery forms that

exclude some of the contact information. With blockchain technology, customer data privacy can be further safeguarded, improving and securing their purchasing experience (Zakharkina et al., 2022).

The disruption caused by technology adoption at varying levels can impact logistics processes to varying degrees (Klumpp & Loske, 2021). Technology can also expose logistics companies to vulnerabilities that create opportunities for hackers. Indeed, cyberattacks have been launched against the largest logistics companies—including the Danish-owned shipping company AP Møller-Maersk in 2017; the COSCO terminal in Long Beach, California, in 2018; and Australian 3PL provider Toll Group in 2020 (Cheung et al., 2021). Operations stoppage at such companies can incur losses of approximately $200 million per day.

However, blockchain technology has increased control of downstream activities in the supply chain network. For instance, by integrating blockchain into their existing supply chain management, providers can create and share a distributed digital account book among computers in a network. Although the provider owns the book, it can be viewed by diverse actors that operate in the supply chain and thus improve the overall level of transparency (Akkaya & Kaya, 2019).

II.9 Summary

Using technology to support physical services is now considered a competitive advantage for logistics providers (Sohn et al., 2017). These providers adopt digital innovation to improve their performance measures (Hazen & Byrd, 2012) and to develop and provide knowledge and technological skills that their customers require (Marchet et al., 2017). To succeed with this process, providers must develop familiarity with their customers' businesses and expectations and thereby address key aspects of outsourced services that support the essential aspects of their

supply chain. This type of provider–customer relationship cultivates long-term partnerships. Hence, firms often refer to their logistics providers as their *supply chain partners*.

In both academic and practitioner journals, articles on the technology investments of traditional logistics providers often discuss the technology they use to improve their operations. These innovations allow them to augment their labor resources and thus retain a competitive advantage by reducing costs, providing innovative and customized services, and improving service quality (Lai et al., 2004). New technological innovations often track and manage performance based on customer expectations and performance indicators. While these factors are critical to customers, most articles about these firms focus on one aspect—the impact of digital innovations and their adoption in logistics processes—and neglect attributes that impact the firms' performance. As Mathiassen (2017) defined it, this creates an area of concern in the literature related to a real-world problem—that is, addressing what factors they should consider in prioritizing investments that contribute to positive performance implications.

Providers are continuously inundated with pressure to pursue digital change from their customers, employees, business partners, and competition—as well as pressure from the entrance of new competitors in the market (Cichosz et al., 2020). Despite these adverse impacts, the internet and the proliferation of logistics software have given the logistics industry an unprecedented boost in efficiency in responding to changing market demands, which has opened up opportunities for digital start-ups (Mikl, Herold, Ćwiklicki et al., 2021).

To summarize this chapter, the literature posits that technology adoption supports logistics providers and is imperative for firms providing outsourced services to ensure that it provides value to the firm and supports customer requirements. This research study uses its

extensive literature review to validate concepts and constructs that comprise the framework in Figure 5.

A study of the benefits and challenges of smart technology adoption to logistics providers is rarely covered in the literature. Most findings in prior publications focus on specific technologies such as blockchain, RFID sensors, and smart warehouses. These existing papers lack a broader view of smart technology adoption. Indeed, most logistics providers offer a wide array of services. This study can help them prioritize and examine the outsourced logistics services offered. It will also be a useful reference and help to guide their investments. It would also help to ensure that such investments positively impact a firm. As existing work shows, the ubiquity of smart technologies available to provide logistics processes to customers creates a real-world dilemma (Mathiassen, 2017) for providers in the outsourced logistics industry.

Types of logistics providers continue to develop along with technology. This situation is another gap in the existing literature. All users—logistics providers, their customers, intermediaries, and other actors in the supply chain—are constantly inundated with new technology and the need to update existing systems.

Each year, award-giving bodies evaluate the best supply chain technology trends. DHL's Innovation Center developed *Logistics Trend Radar,* a mechanism tracking technological innovations since 2012, and the center itself has become a world-renowned consulting firm. Consultants and organizations like Gartner's Magic Quadrant must regularly update their categories to stay current with market dynamics. This ubiquity of smart logistics technologies presents a dilemma for providers in prioritizing technologies to adopt, particularly given the wide-range of products and services many providers offer.

Providers are vulnerable when selecting technologies to adopt, as doing so might neglect or endanger other services in their business processes or fail to generate the needed resources. Regardless of such choices, providers must continue to deliver performance to their customers and generate income for their firms. These dilemmas drove the formulation of my research questions:

What factors should logistics providers consider during smart technology adoption to increase their firm's value despite resource constraints (RQ1)?

What are the nonfinancial benefits of smart technology adoption for logistics providers? (RQ2)

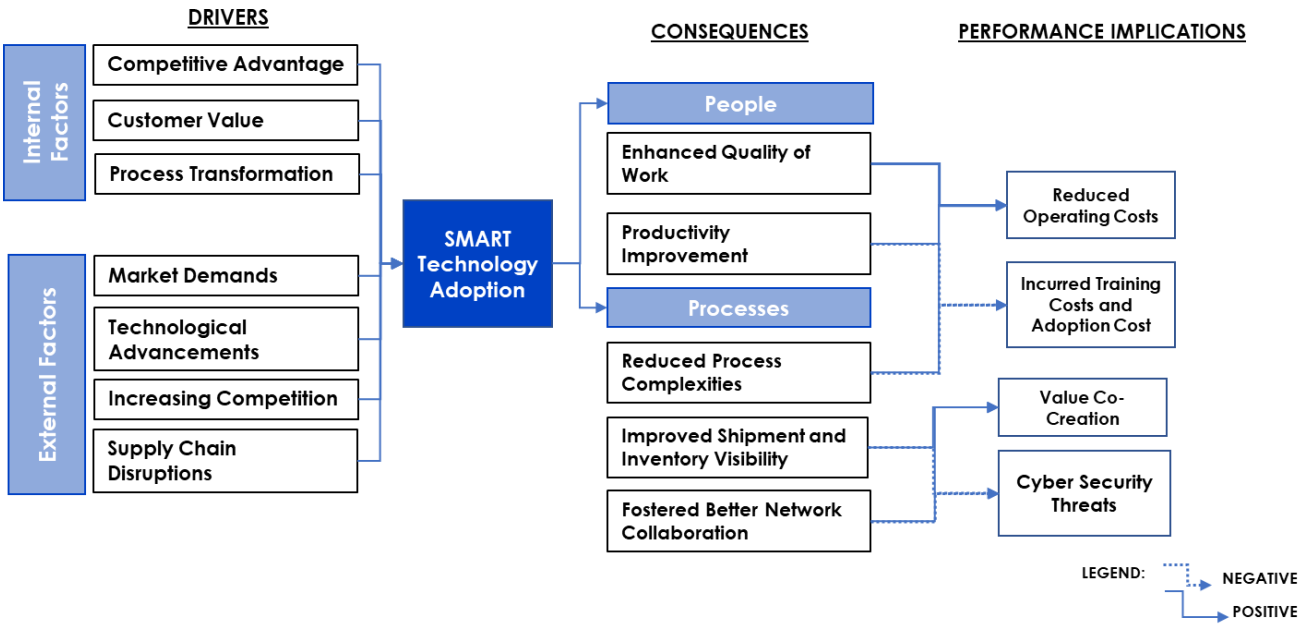

Figure 5 Conceptual Framework

III CHAPTER 3 RESEARCH METHOD

Some articles posit the industrial revolution's influence as a catalyst in supply chain technology adoption as a general concept. The evolution of manufacturing and production from the first industrial revolution became a challenge for manufacturers, requiring them to outsource logistical functions in their supply chains. In contrast, internet-based and -related technologies became a conduit between merchants and buyers, creating additional supply chain complexities. Then, as globalization progressed, it prompted new requirements for speed and instant gratification in the fourth industrial revolution.

Logistics is the key driver of current supply chains; as extensions of businesses, logistics providers play a critical role in providing services to address changing demands. It is inevitable that these providers adopt technology and continuously adjust their technological processes to keep up with these demands. As businesses further evolve into manufacturing and production, outsourced companies must keep up with their demands by adopting new processes and adjusting their existing systems and technologies.

In reviewing the literature, I identified themes, drivers, and consequences. I clustered two types of drivers—internal factors or firm-based external or market-driven factors—that triggered logistics providers' smart technology adoption. The IoT and Big Data increased productivity and improved internal performance (DOUAIOUI et al., 2018; X. Zhang & Bartol, 2010), enabling the interconnectedness of intertwined processes in the supply chain. These firms also adopted smart technologies to improve their performance and that of their customers' supply chains (Panayides & So, 2005).

In addition to these internal factors, external factors also prompted providers to adopt smart technology. The literature notes both positive and negative external factors as driving this technology adoption. Positive factors noted include technological advancements that boost

digital capabilities in the supply chain network (Chung, 2021; Nasiri et al., 2020; Tiwong et al., 2020), increased network collaboration and transparency (Akkaya & Kaya, 2019; S. P. Cho & Kim, 2017; Kalkha et al., 2023)(Cho & Kim, 2017, Akkaya and Kaya, 2019, Kalkha et al., 2023); and evolving customer demands (Kalkha et al., 2023).

To offer an in-depth analysis of data gathered from the outsourced logistics industry, I use a thematic analysis to address my two research questions:

What factors should logistics providers consider in smart technology adoption to increase their firm value despite resource constraints (RQ1)?

What are the nonfinancial benefits of smart technology adoption for logistics providers? (RQ2)?

III.1.1 Reliability and Validity

To ensure data reliability, concept validity, and the external validity of my analysis, I used the transcripts of my interviews with 40 interview participants from global logistics providers' firms, which varied in size and services offered, as empirical evidence to define the factors that impact technology adoption. Based on Yin's grounded theory approach, I improved reliability by organizing my questions in a specific order. The questions are available in the Appendix section of the document. The questions are clustered to validate or invalidate concepts gathered in the literature based on the interview participants' information.

The literature posited that the evolution of the supply chain followed the industrial revolution, so I asked participants about the nature of their company's business and its current business model. The semi-structured questionnaire allowed for follow-up questions about the current services of participants' firms. I investigated whether the firms had added or eliminated other products or services and, if so, why. I also asked what year the business was established if I

could not find this information through secondary data on the internet or in trade sources. By identifying the date the business was established, I determine the number of years it had existed and at which stage of the industrial revolution it was established. A firm's longevity also helps to identify company milestones associated with technology.

The next set of questions examined any changes in ownership and how such changes impacted the firm's services and technological adoption. I asked about the approximate length of the customer relationship and the factors sustaining this longevity. I followed up with questions about the provider's customers to establish the correlation between customer relationships and technology adoption.

The next set of questions focused on the company's current challenges and how they were addressed—whether using smart technology adoption or other methods. I asked follow-up questions for any other methods that respondents identified to clarify the initial responses.

The next set of questions I asked directly related to the firms' adoption of smart technology. These questions included reasons for choosing the technology as the primary priority for their organizations to assess drivers in prioritization. I then asked questions to determine the impact of technologies on their firm's current processes, resources, and systems to assess the impact in relation to a firm's "*excess baggage."* Finally, I asked participants how their organizations measure the impact of adopting these technologies, both (1) internally, to assess the benefit to the firm; and (2) externally, in terms of how these technologies are measured on their customers.

To assess the questionnaire's validity, I assessed the answers independently for every interview. I also used secondary data to determine construct validity by adding another source of evidence—such as by researching the company's website and other information published about

the company. External validation of findings into other organizations can be done once my case study's findings are known. At that point, I can study other provider firms or their customers to generalize my study's results. The replication logic will then be driven by the theoretical homogeneity of these organizations as logistics providers.

III.1.2 Selection of Participants

The research firm IBISWorld (www.ibisworld.com) reported that in 2022 there were 20,410 3PL companies in the United States alone. It defined these companies are those that typically provide integrated supply chain solutions, some of which might be classified as 4PL or LLP. IBISWorld aggregated the number of companies based on all activities, including logistics consulting, transportation management, forwarding, packing, freight brokerage, warehousing, and dedicated contract carriage. While research on the number of global logistics providers is unavailable, U.S. information helps to indicate the size and scale of the global market, especially in other countries with active markets, such as China and Mexico.

The sheer number of global players proved beneficial in selecting participants. A quick search on LinkedIn helped me to identify more than a hundred potential connections among industry peers and previous colleagues in the United States alone. I sent quick instant messages through LinkedIn, with a commitment to email a consent form and a list of questions. Half of the people I sent chat messages responded, and 40% provided an email address. Although I have good business relationships with potential participants, I was aware of possible company confidentiality or policy considerations. Following this process, 70 potential participants remained. Of them, 11 respondents declined to participate for reasons such as corporate policies, volatility within the company (either undergoing restructuring or mergers and acquisitions), the individual's inability to respond on the topic, and busy work schedules. Ultimately, 33

participants agreed to participate in a recorded field interview for my research. These participants signed the Informed Consent Form approved by the Georgia State University Institutional Review Board (GSU IRB) available in the .

The number of interviews that qualitative studies use depends on their homogeneity or heterogeneity and the sample; there is no *one-size-fits-all* to reach data saturation. My initial interviewees include heterogeneous characteristics regarding the size of their firms, the company's ownership and structure, titles and functions, gender, and race. The literature states that 35 is the mean number for most qualitative research; some researchers consider 30–50 in-depth interviews large enough (Kindsiko & Poltimae, 2019).

So, my initial number of participants will allow me to reach a data saturation point. However, the literature review included concepts on globalization and its impact on the supply chain. Furthermore, some articles considered in the literature review section are written from a perspective outside the United States. Logistics is the aspect of supply chains that interlinks global components discussed in the literature review section. Therefore, it was imperative to gather data from other countries to validate the U.S. findings. I, therefore, added 7 participants—out of 13 industry practitioners contacted—to represent other countries (Mexico, France, Indonesia, Brazil, China, Turkey, and India). Then, my study of this complex real-world phenomenon included 40 diverse participants (Van de Ven, 2007). It is imperative that the interviewee possess lengthy logistics experience and influential to decision in their organization. A list of participants' profiles is detailed in Table 1.

Table 1 Interviewees Industry Experience

Reference	Industry Experience (in years)	Position	Research Categorization
A	33	CEO	C-Suite
B	18	CEO	C-Suite
C	15	CEO	C-Suite
D	17	SVP Healthcare Vertical	Sales
E	23	CEO	C-Suite
F	22	SVP Corporate Business Development	Sales
G	32	CEO	C-Suite
H	27	SVP Global	Others
I	28	CEO	C-Suite
J	23	CEO	C-Suite
K	18	SVP	Department Head
L	16	Sr. Director Corporate Strategy	Department Head
M	24	CEO, President	C-Suite
N	20	COO	C-Suite
O	15	Regional Sales Manager	Sales
P	33	President	Company Head
Q	5	Sales Director	Sales
R	38	Co-founder	Company Head
S	32	CIO	C-Suite
T	27	SVP eCommerce	Sales
U	11	VP Strategy	Department Head
V	26	Regional Director	Department Head
W	36	Sales Managing Director	Sales
X	33	COO	C-Suite
Y	28	Head of Marketing	Department Head
Z	16	SVP China	Department Head
Z2	27	SVP, Sales	Sales
AA	46	CEO	C-Suite
BB	22	IT	Department Head

CC	35	CEO	C-Suite
DD	29	Director Business Development	Sales
EE	9	President	Company Head
FF	17	SVP BD	Sales
GG	16	Head of Growth	Sales
HH	33	CEO	C-Suite
II	32	CEO	C-Suite
JJ	19	Chief Commercial Officer	C-Suite
KK	21	Director	Department Head
LL	33	CEO	C-Suite
MM	19	Country Sales Manager	Sales

When putting out the call for respondents, I limited my outreach to people who were directors or higher within a firm. Prior research shows that managerial decision-making and technology adoption are strongly correlated (Al-Mamary et al., 2013; Kiradoo, 2020; Mathauer & Hofmann, 2019; Oliveira & Martins, 2011). While decision-making usually depends on a firm's top leadership, these leaders often seek insights from various levels and functions. I chose many different higher-level titles and positions within logistics provider firms to achieve a well-rounded perspective.

Of the 40 research participants, 20 are company leaders. Of these, 18 belong to the much-coveted C-Suite, with 13 chief executive officers (CEOs), two chief operating officers (COOs), one chief information officer (CIO), one chief commercial officer (CCO), and two company presidents. Of the remaining respondents, ten hold titles ranging from director to executive vice president in sales and related functions, where they are typically in charge of customer-facing responsibilities. The remaining respondents have titles ranging from director to senior vice president in operations and IT.

III.1.3 Company Structure

I classified the 40 companies that the interviewees represented based on the type of logistics services they provided, the business type, length of operations, company ownership, and size. Tabkle Although there are no official definitions of *logistics service providers*, I combined multiple definitions from literature (Hanus, 2013; Lai, 2004; Marchet et al., 2017) with the practitioners' definitions based on their services and operational capacity to categorize providers into three types: full-service; niche providers; and subsidiaries, divisions, or business units of a parent company. Of the respondents, 23 are from full-service firms that offer various logistics services to clients and may extend customization to capture more business, and 14 are from niche

provider firms. Despite providing a wide range of service offerings, these niche providers pride themselves on specialization in handling certain products or commodities, including high-value products, perishables, and chemicals. The remaining 3 participants are from a parent or holding company's subsidiaries, divisions, or business units. These providers are usually established or acquired to support other services of the larger company, yet they may have independent financial responsibilities or leadership positions.

Literature posits that the development of logistics outsourcing parallels the evolution of industrial development. I found that provider business longevity varied from less than one year to more than 50 years. Of the participant firms, 16 have existed continuously for 30–50 years; 6 for 20–30 years; 9 for 10–20 years; and 6 for less than ten years. Of those 6, 5 firms are new and had only been established within the past five years. I also identified any change in ownership and whether such a change impacts a company’s smart technology adoption.

The literature states that firm size impacts logistics providers’ technology adoption (Mathauer & Hofmann, 2019), and thus assessing the revenue or valuation was critical to this research. For privately owned and not publicly traded companies, information on size is limited and typically withheld. In my study, 22 participants’ firms are private-equity owned, 11 are publicly traded, and 7 are family-owned companies. While financial information is available for publicly traded companies, I needed to capture information on company size for private companies. Yet, such information is not available unless the company is private equity owned. I used secondary data to determine the size of publicly traded companies and relied on the respondents to share either their firm’s valuation or revenue in 2019. I set this boundary to convey company size using more realistic figures to avoid temporary inflation of logistics firms’

financial standing during the pandemic (Atayah et al., 2022; C. Tsai et al., 2021). Tables 2 and 3 present a detailed list of the summary of firms based on the criteria described above.

Table 2 Provider's Business Structure

Criteria		No. of Respondents
Business Tenure	Less than 5	5
	6 to 10	3
	10 to 20	5
	20 to 30	1
	30 to 40	3
	40 to 50	3
	Over 50 years	20
Type of Business	Full-Service Logistics Provider	23
	Niche Provider	14
	Subsidiary or Business Unit	3
Ownership	Family Owned	7
	Private Equity Owned	22
	Publicly Traded	11
Size	100M and below	11
	> 100M but less than 1B	8
	Over 1B	19

Table 3 Business Evolution

		No. of Responses
Change in Ownership	Changed	22
	Not Changed	18
Other Services Added	One service added	2
	Multiple services added	27
	Completely changed services	5
Change in Structure	Acquisition	15
	New Products/Services/Solutions	26
	Geographical Expansion	2
	Diversification	6

The diversity of firms and participants contributed to the generalizability of findings, as I detail later in Chapter 2 "Findings and Discussion" section.

III.2 Data Collection Method

III.2.1 Interview Preparation

The GSU IRB Informed Consent form approval (Appendix 1) initiated the data collection process. I sent research participants an email detailing the study's scope and purpose. I notified participants of information that might be requested during the research, including their roles and function and details about their organization. The informed consent stated that the interview duration would be 30 minutes to one hour for the initial session and, if needed, a follow-up session of 30 minutes or less might be conducted to clarify or gain additional insights on information from the first session. I committed to providing a copy of the questionnaire for the interviewee to review. I notified them of the boundary limitations for canceling, skipping certain questions, or stopping the interview at any time, even with signed consent.

I pre-notified participants that audio and video recording would occur during transcription and data coding; I also took notes electronically. Upon identifying the respondent's availability, I sent calendar invitations with Microsoft Teams or Zoom access as a connection method for the virtual meeting. The calendar invitation also served as a reminder for the participant and offered a means to request a schedule change in case of a conflict. To store the information, I committed to password-protected cloud storage (Microsoft OneDrive) and a backup (Google Docs), which will be permanently deleted after the completion of the study.

III.2.2 Field Research

During the interview, I reiterated the process described in the informed consent to further expound on the information stated. Before asking questions, I also advised the respondent of the confidentiality arrangement: that I would not disclose their names or that of the company they

represent in any document. Ensuring the participants of the process helped to ensure that they would be less likely to withhold information useful to the study.

I conducted semi-structured interviews using the preformulated questionnaire to ensure consistency while allowing new questions to emerge during the conversation. In semi-structured interviews, respondents commonly talk freely and volunteer valuable insights. Such a free-flowing discussion may be advantageous and disadvantageous (Myers, 2020). Some interviews lasted for the entire duration because of the respondent's eagerness to share information. In some cases, information was not relevant to the study. A few interviewees agreed to proceed with the interview despite being pressed for time or experiencing an urgent situation. In such cases, I failed to capture critical information about their company during the interview. I, therefore, sent follow-up questions via email. Unlike the field interviews, this email correspondence did not open opportunities for improvisation; instead, I had to rely solely on the substance—or lack thereof—in the written replies.

III.2.3 Data Recording

I coded each file—both the audio and the transcribed version—with letters to ensure the integrity of the research, using a cloud-based platform (Google Sheets) to secure the data. Participants were assigned letter codes and a corresponding company role as identifiers to preserve anonymity. I did not evaluate, code, or analyze the respondents' answers. Instead, I entered the data according to the research questions to categorize the answers and to visually simplify the transcriptions.

Some interviewees chose not to reveal company-related information during the interview proper. I scoured secondary data online and entered available information from the company's

website to find missing data. I transcribed all of this in the working file. Data from the responses were organized as presented in Table 4.

Table 4 Extract of Data Organization Process

	Interviewee's Role	Services Offered when Business was Established	Other services were added	How company evolved to its current structure	Factors in sustaining relationship	Challenges in the company	How technology addressed the challenge	Reason for prioritizing the technology	Implementation impact on current resources
B	CEO	moving and storage company with a rug cleaning service	warehousing build warehouses, fill them up and turn the warehouses over to investors and generate equity freight forwarding	through acquisitions, moved away from storage and focused on public warehousing	during acquisitions, kept the account management team, the leadership teams of the other companies. we had the seniority, the tenure, the customer knowledge.	growth different cultures Rebranding	own system - bought the rights to the code and we brought it in-house. Have been using it throughout these years and continue to keep it updated, which now is a competitive advantage for us. MercuryGate- to simplify different transportation systems we were using	developed own system for 3PL to support the growth of the company	generated additional EBITA cost reduction on the labor side slight drop in revenue on the open book accounts took a lot of training
E	CEO	Roadrunner was a little carrier that got bought by a private equity firm	(Roadrunner) bought different businesses and put them together - TMS, brokerage, non asset based logistics / asset light logistics,	spun off from parent company	providing good services	parent company ran into financial difficulties which affected all other entities	ANOVA - common brokerage across the organization Project44 - visibility	same visibility uniformity functionality	additional cost
F	SVP Corporate Business Development	co-loading	added freight forwarding	focused on direct customer business	customer service solution-oriented	lack of capacity (finding the balance between technology and capacity) finding balance between technology and customer service	tracking and tracing visibility reduced manual work / operational efficiency	automation "Our system is fed by 18 different other systems, all the data is kind of collected in one location"	there's always resistance at the start when we roll out the technology, it's a little bit of a pain because it's something new. we roll something out, we go office by office
H	SVP Global Freight Forwarding	Started with dedicated fleet trucking delivery	Followed by warehousing, acquired real estate, added freight forwarding 15 years ago	Added a new business unit- Freight Forwarding into the structure	Owner Engagement Quick decision-Making Efficiency	Capacity shortage labor lack of volumes (FF)	Digital Twins- Modeling, solutions supply chain, Network Design Cargowise - increased visibility lifecycle of goods API	Profitability Speed of revenue conversion Information processing	Speed of processing Speed of receiving information Increased Accuracy

III.3 Data Analysis

To determine novel concepts in smart technology adoption, I used thematic analysis to identify themes and patterns in the data. The thematic analysis captures semantic and latent themes. Semantic themes emerged directly from the data. Previous industry experience as a practitioner enabled me to interpret and make sense of the data to conceptualize latent themes. I used Microsoft Excel, an acceptable manual method, to organize my research observations into themes (Braun & Clarke, 2006). I followed the recommendations of Miles, Huberman, and Saldana in displaying the data using row and column headings and links to necessary concepts in the data. The tables below display the condensed data based on my in-depth analysis and interpretation (Miles et al., 2020).

III.3.1 Coding Process

I organized the interview data using the data-analysis software NVivo to aid the process of data condensation. NVivo is an acceptable qualitative research tool that supports classifying, sorting, and arranging data and its relationships through linking, shaping, searching, and modeling. The software guided my analysis of the unstructured data transcribed from the audio and video recordings and captured notes taken electronically. During this initial coding phase, I entered datasets verbatim.

One of the challenges of semi-structured interviews is that the discussion sometimes moves back and forth in time. While coding the raw data, I categorized similar or related answers according to the question. In the process, I realized that information pertinent to one question sometimes emerged in response to other questions. The data that unraveled was coded as part of other questions as part of the coding process. I uploaded the coded file to a password-protected Google Drive. For future reference, I also uploaded back-up copies of the audio format and a

transcription of all interviews to the same storage. This process was aimed at ensuring accuracy for verification of the interview transcripts.

III.3.2 Thematic Analysis

In this analysis phase, I identified common themes focusing on a more abstract, or lower level, inference interpretation to exploit the explicit description of the content with a limited reflection of its implicit meaning (Vaismoradi et al., 2016), where the theme yields practical results extracted from the data analysis. Vaismoradi (2013) defined a *theme* as an attribute, descriptor, element, or concept. I condensed semantic and latent themes following Braun & Clarke's six-phase nonlinear guide analytical process to facilitate the thematic analysis of complex data. Reflexive thematic analysis (RTA) is a more contemporary approach applicable to this research. RTA is an easily accessible and theoretically more flexible interpretative method using coding reliability approaches (Byrne, 2021). Following is a detailed account of the phased process I used to analyze the raw data.

III.3.2.1 Familiarization with the data

I gathered data through video interviews, which was the preference of all participants. I recorded and transcribed all interviews using Sonix.ai, a highly rated transcription software. Although some authors recommend manually transcribing such recordings, I opted to familiarize myself with the data by rereading the transcriptions, noting any transcription errors, and interpreting the responses. I also took seven pages of copious notes during the interview to highlight both important aspects of the interview and unique ideas that might be useful in the analysis phase.

Figure 6 Example of the Note-taking process

Question 5. Factors in sustaining customer relationships Decades of customer relationships, ability to make their supply chain resilient, optimal customer experience, competitive pricing Question 6. Challenges in the company; how smart technologies addressed the challenges Lack of understanding among various levels of the organization; (these were addressed by) executive market updates and whiteboarding (sessions), workshops, and extended support. Question 8. Reasons for prioritizing technology Technologies enhance visibility processes; make informed decisions through tools that give analytics

These notes are verbatim examples of interesting observations that I analyzed using a semantic approach, where I identified themes within explicit meanings.

III.3.2.2 Generating initial codes

Codes are building blocks that will later be conceptualized into themes. In this phase, I manually conducted preliminary coding iteration in an Excel file, identifying sufficient details that inform fields relayed to the interviewees through semi-structured questions that encourage improvisation. Although this starts with a similar set of questions, the coding process reveals new information that might have been missed during the interview (Myers, 2020).

I followed a two-step process to create the initial coding. First, I organized the transcribed responses into a simplified structure, manually grouping them based on each question. Responses were not always in the order of questioning. Also, because some questions are related, concepts

emerged from other answers. Respondents' statements are based on sociocultural contexts, and I analyzed and grouped them in a constructionist approach following the iterative analytical process (Braun & Clarke, 2006).

The transcription software I used converted the speech into text in a Microsoft Word document, as the following example shows:

Figure 7 Actual interview transcript

Speaker1: [00:06:20] So there's resistance to change to to newer processes and technologies.

Speaker2: [00:06:27] Yes. So the process. Because. Because we started the transformation, I think, one and a half years ago. Okay. My path given by the honor is to merge two companies operation.

Speaker1: [00:06:48] Okay.

Speaker2: [00:06:49] So formally, they have two holding companies in the market and they compete with each other.

Speaker1: [00:06:58] Okay.

Speaker2: [00:06:59] And so the first task given to me is to merge the company. And when we merge the company, it is not only merging the business, but also we are evaluating the business process, the structure of the organization, and also the reconfiguration of the system. And so we change when we change the business process. There are many people here at the ground level. It's very difficult to follow the new process.

Speaker1: [00:07:42] Okay.

Speaker2: [00:07:43] The new process.

Speaker1: [00:07:44] Right.

Speaker2: [00:07:45] And. That makes us more trouble because the system now has not been reconfigured fully. So we have we also changed we also changed the logic of the system. But it is not really it is not yet a full arrangement. So some parts are still performing the old process and also the old system configuration. Some already new.

Some interviewees are from countries where English is a second language. While I understood the interviewee's spoken words, the transcription software did not always capture the correct word or context. In the sample above, for example, the respondent is from Indonesia. In the response in the second line, "*my path, given by the **honor**…," honor* was supposed to be the *owner* (of the company). In this case, I went back to the first phase of the process—

familiarization with data—and interpreted the response based on my knowledge of the interviewee, who holds a high-level position in a family-run business. I, therefore, interpreted that he received direct instructions from the firm's *owner*, who manages the company.

Some other research participants also had strong accents or were non-native English speakers, which required that I closely evaluate their transcription results from the software. In all such cases, I applied an iterative approach, reverting to phase 1 (familiarization with the data) and phase 2 (generating initial codes) to ensure that pertinent concepts and ideas were captured in the transcription.

Accent issues are relatively straightforward; however, industry jargon is less common to non-industry practitioners and must be decrypted into common terms during data organization. In this iterative process, I examined every answer in the coded file and re-evaluated them to ensure accuracy in capturing—and clearly conveying—pertinent information.

The actual coding took place as a second step. While some responses were explicit, I categorized other answers based on my interpretation. The categorization process established the demarcation and did not exploit the flexibility enjoyed by employing a thematic analysis (Braun & Clarke, 2006). The advantage of thematic analysis is that its flexibility is not limited to theoretical boundaries based on key information that drives the themes.

Figure 8 below show the categories I assigned to identify the themes that emerged from the responses. For example, *Service Quality* is a combined concept based on different responses to factors that sustain customer relationships. The interviewees provided their terms to describe service quality, including providing quality goods and services, services with competitive prices, dedicated services, focusing on one service to allow the company to excel, excellent customer service, location, availability of services within a specific vicinity, and commitment to serve.

Challenges in the company: Emerged themes from participants' responses

Reason for prioritizing the technology: Emerged themes from participants' responses

Factors in sustaining relationship: Emerged themes from participants' responses

How technology addressed the challenge: Emerged themes from participants' responses

How company evolved in its current structure: Emerged themes from participants' responses

How impact is measured on customers: Emerged themes from participants' responses

How impact is measured internally: Emerged themes from participants' responses

Figure 8 Condensing data into THEMES

III.3.2.3 Generating the themes

In this phase, my focus shifted from the interpretation of individual data to the interpretation based on aggregate meanings across datasets. I analyzed similar codes and collapsed each into an overarching theme representing multiple codes, which must represent meaningful information that supports the research questions (Braun & Clarke, 2013). Some themes are distinctive, which I initially categorized as others. I also identified contradictory themes for positive and negative representations of datasets and eliminated any codes that did not fit into the analysis (Byrne, 2021).

I synthesized the responses based on the questions and interpreted them in relation to themes that address the research question. For example, to determine how changes to a company structure impact smart technology adoption, I grouped responses to the question "*How did the company evolve into its current structure?*" into four key themes: acquisition, new products/services/solutions, geographical expansion, and diversification.

To determine the correlation between customer relationships and smart technology adoption, I asked questions to determine factors related to six key categories: service quality, client relationship and knowledge of client business, integrated processes/transparency, quick decision-making/resiliency, and continuous improvement.

I asked questions about company challenges to elicit opposing perspectives related to smart technology adoption. I categorized these questions into five themes: revenue growth, technology, market demands, labor, and productivity. To expand on the topic further, I asked respondents to enumerate how smart technology addressed their firm's challenges. The themes that emerged from this question included increased productivity, visibility, customer value, augmented labor, and improved processes. While adopting smart technologies is critical for logistics providers, the literature posited that adoption has constraints. Therefore, prioritization is

imperative to adoption; this requires that I identify factors used to identify technologies to adopt. I categorized these factors into five themes that drive smart technology adoption: financial improvement, new business acquisition, customer retention, business growth, and process improvement.

The other research questions addressed how smart technology adoption impacted the organization. I prioritized three key functions that adoption potentially impacts: human resources, existing processes, and finance. I identified positive and negative themes for each of these concepts. Regarding human resources, smart technologies augmented labor and increased productivity (positive effect); increased training and adoption costs and created change resistance (negative effect). I categorized data on the positive impact on existing processes into five themes: promoted better integration, enhanced visibility, increased speed, and accuracy, allowed process centralization and consolidation, and streamlined processes. A few respondents claimed that smart technology adoption had no significant impact or benefit on the firm's processes. Some firms claimed that technology created a positive effect by offering a single, integrated platform for functions and services. In contrast, others cited a negative effect in terms of delaying/slowing down systems integration.

To assess the effect of smart technology adoption, I asked respondents about how their organizations measured the impact of smart technology in two categories: internal and external. Four themes emerge in the data regarding how the respondents measure the technology's internal impact. While some stated that there are no direct, recognized cost–benefits, others apply productivity measures or key performance indicators (KPIs), assess financial returns, or use customer satisfaction metrics. Themes related to customer satisfaction are gathered through

transparent and open feedback during business review meetings, through the input of account management teams, or through systematically using metric-based indicators.

To assess the importance of technology for provider firms, I asked for any future smart technology adoption plans; here, five themes emerged. Most respondents are either planning to implement or are on their way to implementing new systems and technologies. Some will add functionalities or enhancements to existing systems, while a few completely change their current systems. Other respondents claim they have no plans or are unaware of any plans from their organization. Tables 4 to 5 presents the summary of themes that emerged from the data:

Table 5 Customer Relationships

Criteria	Themes	No. of Responses
Length of customer relationship	**0 to 10**	**6**
	10 to 20	**10**
	20 to 30	**7**
	Over 30 years	**16**
Factors sustaining customer relationships	**Service Quality**	**11**
	Client Relationship and Knowledge of Client Business	**18**
	Integrated Processes/Transparency	**6**
	Quick Decision-Making/Resiliency	**1**
	Continuous Improvement	**1**
	Others	**1**

Table 6 Issues and Challenges

Criteria	Themes	No. of Responses
Current Challenges	Revenue Growth	11
	Technology	13
	Market Demands	3
	Labor	9
	Others	3
Process and Technology Change to address issues/challenges	Financial Improvement	7
	New Business Acquisition	7
	Customer Retention	16
	Business Growth	3
	Process Improvement	25
Smart Technology Adoption Consequences/ Outcome	Increased Productivity	6
	Visibility	17
	Customer Value	2
	Augments Labor	3
	Process Improvement	22

Table 7 Smart Technology Adoption Impact

Criteria	Themes	No. of Responses
Impact on Human Resources	Augments labor (+)	9
	Increased training and adoption cost (-)	20
	Resistance to change	9
	Increased productivity	9
Impact on Process	Promoted better integration	3
	Enhanced visibility	3
	Increased speed and accuracy	16
	Allowed process centralization and consolidation	4
	Streamlined processes	12
	No benefit	2
	Others	1
New Systems	No Impact or N/A	18
	Single / Integrated Platforms	12
	Delayed/slowed down systems integration	10
	Others	1

Table 8 Measure of Smart Technology Adoption

Criteria	Themes	No. of Responses
Internal Organization	No direct cost-benefit recognized	11
	Productivity Measure	31
	Financial Return	8
	Others	1
Customer	Transparency	19
	Metric-based Customer Satisfaction	20
	Customer Retention	7
	Not measured or N/A	2
Future Plans	Implementing new systems/tech	8
	Adding functionalities or enhancements	19
	Completely changing current systems	1
	No future plans or N/A	12

III.3.2.4 Reviewing potential themes

After identifying the themes, I reviewed the coded data based on the entire dataset (Braun & Clarke, 2013) to determine whether the interpretations addressed the research questions. In this phase, I revised incongruent themes deemed unnecessary to address the research questions. The most challenging step in the data analysis phase is technology categorization. In the initial coding process, I typified technologies based on providers' specific usage described in the interviewee responses to set the boundaries within the case limits (Miles et al., 2020).

The data shows that some firms use more than one system. Some systems provide a single function, while others perform multiple functions. In this step, I categorized the most into general themes.

Finally, I clustered functions and created new themes using a high level of abstraction based on the technology's utility. The new themes eliminated excess diversity and narrowed the range to create coherence. Figure 8 illustrates a diagram of the process.

I applied the same high-level abstraction process to categorize other responses, including (1) factors that sustain customer relationships; (2) company challenges; (3) how smart technology addressed the challenges; (4) prioritization of technology; (5) impact of human resources, existing processes, and current systems or technologies; and (6) how the firm measures impact internally and externally. This process of abstraction led me to contextualize the drivers and consequences of the findings.

Smart Logistics Technologies

Utilization

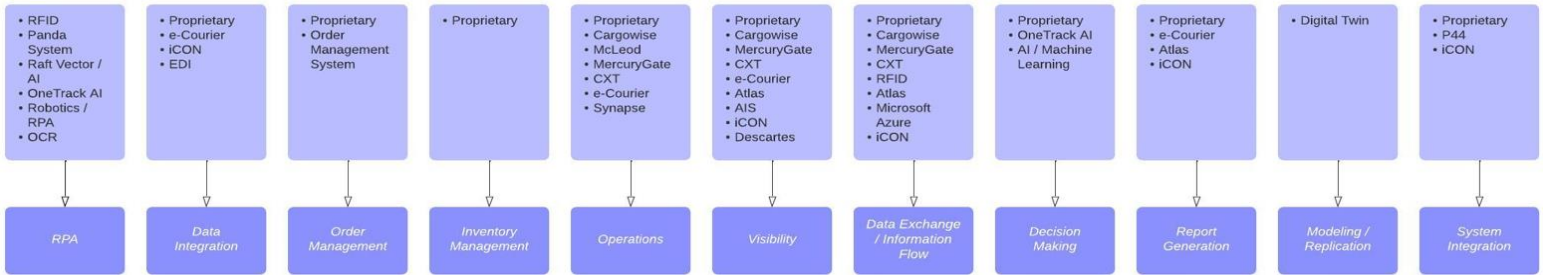

Figure 7. Condensing data into THEMES

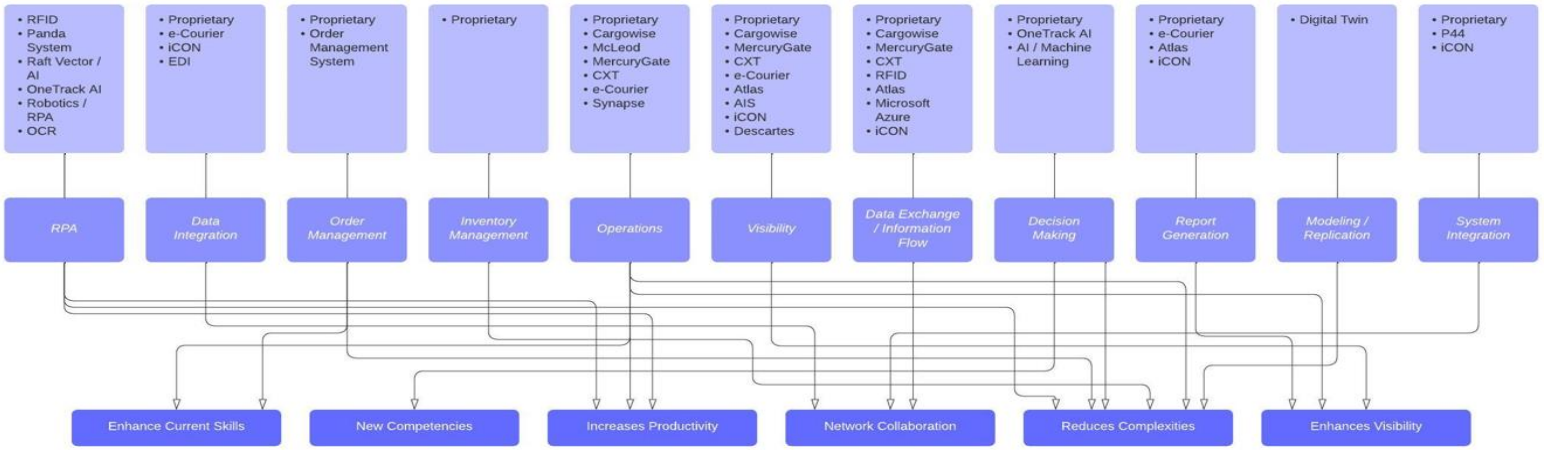

Figure 9 High Level Abstraction

III.3.2.5 Renaming the themes

In the fifth phase, I presented a detailed thematic framework analysis. Defining themes required deep analysis of underlying data from the responses. Upon analyzing the information, I identified redundant themes. While these redundant themes go hand in hand, they require a deeper analysis. I interpreted the data based on the constitutive theme and the broader context of the research questions (Braun & Clarke, 2013).

The most apparent theme is the interviewees' inability to differentiate smart technology's impact on human resources (people) and processes. The in-depth analysis allowed me to extract information and identify sub-themes in the data. In the example above, if increased productivity impacts people, all themes making up the impact on processes were considered sub-themes. In this process step, I contextualized the interpretation of responses for a deeper analysis. I missed out on positive and negative consequences in the second and third phases due to the complexities of the data.

As a final step, I renamed themes as needed to create a more straightforward label for readers based on what the data captured. Braun and Clark ((Braun & Clarke, 2006, 2013) suggested that such names must immediately catch and maintain the reader's attention while communicating an important aspect of the theme.

Borrowing practices from quantitative research, I identified specific themes—which I classified as *drivers* and *consequences*—related to the themes I initially identified. I abbreviated the theme names, but not to the extent of making it too trivial for the reader to misinterpret the themes or the themes and misconstrue each implication.

III.3.2.6 Completion of the report

In the final step, I iteratively compared the qualitative research to its quantitative counterparts. As illustrated in the steps above, the codes and themes evolved in each phase. In this sixth phase, I found logical connections between the themes. Some responses were eliminated and re-emerged based on semantic codes, while latent codes were interpreted according to the interviewees' statements. As Byrne (Byrne, 2021) suggested, the themes were presented consistently. As I describe in detail in the following section, the themes communicate important information independently, even when isolated from other themes.

IV CHAPTER 4 FINDINGS AND DISCUSSION

In reviewing the literature on logistics providers' smart technology adoption, I found that prior studies identified specific drivers that propelled organizations toward this adoption. Research posits that providers are inundated with internal and external challenges that necessitate the adoption of smart technologies. Further, new and emerging technological trends enable logistical processes that support the complex demands of modern supply chains (Kawa, 2012). These processes allow businesses to facilitate raw materials sourcing to production, manufacturing, assembly, and distribution globally through internet connections (Ceniga & Sukalova, 2015).

As many researchers describe, logistics outsourcing evolved with the phases of the Industrial Revolution (DOUAIOUI et al., 2018; Ezzat et al., 2019; Sader et al., 2022; Verma et al., 2020). Fast forward to 2011—the Fourth Industrial Revolution—and we arrived at the point where technological advancements, through IoT, combined with Big Data to create a new environment to plan, manage, and control logistics activities (Bigliardi et al., 2021; Feng & Ye, 2021). Logistics 4.0 was by far the most complex of the phases of the Industrial Revolution (DOUAIOUI et al., 2018) and introduced elements such as intelligent warehouses, smart transportation, and digital twins. These technologies, commonly referred to as *smart logistics technologies,* continue to support the evolving supply chain complexities in businesses.

To focus on their core competencies, companies increasingly outsourced functions as business practices grew more complex. Logistics' challenges grew far more excessive as the number of computer applications increased. The development of eCommerce sales transformed business requirements for speed, velocity, and agility in processing customer orders for both businesses and consumers alike, particularly during disruptions (Bhatti et al., 2020). The internet and the proliferation of logistics software have given the logistics industry an unprecedented

boost in efficiency and visibility due to rapidly changing market demands, which have, in turn, opened opportunities for digital start-ups (Mikl, Herold, Pilch, et al., 2021). Firms expect providers to accommodate their internal and external customer demands (Tiwong et al., 2020)—a shift that requires providers to evolve with market trends. The resulting unprecedented rate of supply chain activities increased challenges for logistics firms (Tripathi, 2020).

The complexities in market dynamics opened more opportunities for more services than firms expected, prompting the evolution of various types of providers (Tripathi, 2020) and the emergence of disruptors in this space (Cichosz et al., 2020; Fulconis & Paché, 2018; Schramm et al., 2019). These disruptors created a new layer of actors between LSPs and their customers (Schramm et al., 2019).

The industry evolution and market changes triggered a shift in providers' physical organizations and processes. Researchers have argued that smart technologies help mediate organizations' digital transformation to support the industry's rapid development and customer collaboration (Nasiri et al., 2020). Evidence exists that these transformations benefit firms' performance by exploiting interdependencies between human capabilities and technological processes (Cimini et al., 2020a). Adopting technologies requires both competent human resources and infrastructure, which requires many capital investments (Kawa, 2012). While long-term cost savings are anticipated (Mathauer & Hofmann, 2019), the total cost of adoption cannot be quantified.

Providers must be intentional in their choices, given the investments required for technology adoption. Customers, however, are not always willing to shoulder the cost of technologies (Wagner & Sutter, 2012) to cover investments and the additional resources and process cost that the adoption entails. Transformation is required for Providers to adopt

digitalized processes (Hofmann & Osterwalder, 2017), and they are continuously inundated by customer requests and market pressures to pursue these digital changes. They also recognize a trade-off between the value to the customers and the cost of adoption (Wagner & Sutter, 2012). Because this value does not always equate to cost savings, the impact on the firms' value is not always immediately clear. Despite the need for smart technology adoption to support customer demands for more complex logistics services (W. Liu, Hou et al., 2021; X. Liu et al., 2010), providers must retain their profitability.

In addition to customer requirements, the market itself dictates providers' need to adopt smart technologies. Recent labor issues in the supply chain industry provoked these firms to maintain or improve current processes using technologies. If providers do not address these market changes, competing firms and new competition will take over their business (Cichosz et al., 2020).

Providers must evolve with the speed of technology. The ubiquitous technologies available to support upstream and downstream logistics processes while developing new ones create another dilemma for providers. They must subsequently enhance their existing technologies while adopting new ones to avoid being outperformed by start-ups (Hopp et al., 2018). The speed of technology development and the unprecedented boost in industry requirements has opened doors for new market entrants and digital start-ups; these industry disruptors create agile processes and digitize processes quicker than traditional providers (Giraldo-Diaz & Fuerst, 2019).

Furthermore, the fragmented processes in various supply chains require a technological connection of interwoven processes among supply chain intermediaries (Alkhatib et al., 2015). In 2022, when Maersk announced that it would discontinue TradeLens, the blockchain

technology application developed with IBM and launched in 2018, it came as no surprise in the industry. According to the company's Head of Business Platforms, Rotem Hershko, TradeLens "has not reached the level of commercial viability necessary to continue work and meet financial expectations as an independent business" (Maersk, 2022). The expected linking of more than 300 members—including ocean carriers, terminals, inland depots, customs authorities, intermodal providers, and other supply chain intermediaries—to view real-time tracking information and documents was not reached after four years of implementation (Trueman, 2022). The company developed the technology in response to data vulnerabilities to hackers and supply chain data breaches. Such data security challenges resulted in millions of dollars in losses for providers, customers, and intermediaries.

Additionally, other natural and artificial disruptions—such as the recent pandemic—have a ripple effect of other related logistical issues and challenges that can halt processes or paralyze an entire economy. During such unforeseen circumstances, technologies are greatly needed for visibility to allow quicker decision-making by providers and their customers so that the entire supply chain network can react accordingly.

Adding to prior academic research, my findings aim to demonstrate that other factors also drive logistics providers' smart technology adoption. In effect, these other drivers resulted in positive and negative consequences that impacted a firm's value; It remains unclear how providers can prioritize smart technologies that positively impact their firms' value and quantify the nonfinancial benefits of their adoption.

I conducted field interviews with 40 practitioners involved in decision-making at logistics providers' firms and identified new drivers and consequences. These factors triggered positive and negative effects on people (human resources) and existing processes in the firms. My study

found that the internal drivers are predominantly positive; I also identified negative external factors that trigger smart technology adoption.

IV.1 Internal Drivers

The internal factors consist of themes and subthemes that drove organizations to implement smart technologies. They made conscious decisions to adopt the technologies to manage their human resources and processes, which they expected to generate financial returns that positively impact their firm's value.

IV.1.1 Customer Value

The definition of *customer value* in literature is ambiguous. Parasuraman (Parasuraman, 1997) attributed value to price, performance, perceptions, service quality, customer satisfaction, and the intention to repurchase or recommend. More recent literature defines customer value based on its utility to the customer (as perceived or received) or to the firm (the customer's lifetime value). For my research, I adopted the definition from the customer's perspective—the preference for and evaluation of attributes that achieve and fulfill customer goals and desires through company products or services (Graf & Maas, 2008; Parasuraman, 1997).

Literature on providers' measurement of customer value is based on reduced cost or the ability to improve business performance (Ezzat et al., 2019). The latter substantiates empirical research that shows that providers' improvement in internal efficiencies and service levels (Sinkovics et al., 2018) constitutes value to the degree that customers' needs are met (Cichosz et al., 2020). Providers' firms rely on the value that their customers perceive them to contribute (Power et al., 2007). Such perceptions go hand-in-hand with customer demands for continuous technological innovations to support their supply chain operations.

Most of the providers in my study have customer relationships that date to the start of their business. Such relationship longevity is evident in the data: 16 out of 40 participants have maintained their relationship with customers for over 30 years, seven have had customer relationships of more than 20 years, and 10 companies have sustained relationships for over ten years. Of the newer companies, 6 out of 8 boast ongoing customer relationships that began when they started less than ten years ago.

Providers define service quality as customer-service-oriented, competitively priced offerings that allow customers to excel and become more competitive. Some providers define quality as dedicated (for those offering customized or customer-tailored solutions) or operations-driven (for those offering standard solutions). For other providers, service quality is the availability of services in an area or location that the customer desires. Most of these service qualities are interconnected with the availability of smart technologies to address what is perceived as service. Providers who define service quality as customization said that smart technologies allow these processes to be tailored to specific customer requirements for their business at much lower costs. On the other hand, the uniformity of processes supports operational efficiencies that convert services to the quality that customers perceive as valuable.

Smart technology adoption has a generally positive effect on customers. Most providers said that they gauge customer satisfaction through metrics and by gathering customer feedback. Smart technology measures providers' KPIs and provides transparency into how they perform for their customers. Some providers achieve cost savings through the open-book accounting and audit processes that technologies allow. Some systems allow data sharing to validate the information that customers generate from their internal systems. Transparency and data sharing encourage regular, open dialogues to improve processes, gather recommendations, and reduce

customer complaints. The providers associated these feedback systems with increased customer satisfaction, leading to business retention and profitability.

In my initial assumptions—which the literature supports—customer value increases based on the premise that providers consistently meet customer needs and improve customer service due to smart technology adoption. Indeed, my study proved that customer value is an internal factor that drives providers' smart technology adoption. To sustain the existing business relationships with customers, providers had to maintain service quality, ensure integrated supply chain processes, and maintain data transparency or visibility.

As the senior director of corporate strategy at a full-service provider headquartered in Asia said, "*Smart technologies allow process integration that immediately translates into customer value*." This sentiment was echoed by respondents at six other companies, who said that process integration is critical to maintaining their relationships. They, therefore, associate this integration as a factor that adds value in keeping customers satisfied. Another respondent stated that their business is "*a highly entangled, sticky service that is hard to extract from* (customer relationships).

Most providers, who also invest in communication to improve their partnerships, perceive customer integration as value. Integration in modern processes is supported by technology, as it allows providers to extend the processes to their customers' intermediaries, customers, and the entire supply chain network. Some providers sent surveys to measure technology adoption's impact on their customers. However, as stated during the interview, they still prefer the direct feedback method to assess the adoption.

IV.1.2 Process Transformation

To meet market demands in a rapidly changing environment, logistics providers allow their internal processes to transform in conjunction with the supply chain's radical changes. The emergence of smart technologies—including the development of robotics and automation or RPA in warehousing, transportation, and distribution, and the use of AI/machine learning in software to provide visibility and prescriptive analytics in inventory management, capacity utilization, and order fulfillment—help providers to keep up with the demands of their customers and their customers' customers.

Process transformation is prompted by the firm's intent to continuously develop its organizational structure or evolve past its current state. These transformations affect other factors, such as the quest to improve productivity constantly, and are also at play. While the literature presented evidence that an increase in productivity is a consequence of smart technology adoption, my research findings show that it is a driver to retaining competitive advantage and managing customer expectations. Nearly 50% of the respondents are with companies operating under proprietary systems as their primary tool, either in conjunction with other systems or on their own. One respondent from a U.S.-based contract logistics organization operates its system for its core warehousing and distribution business. The company invested in acquiring the rights to the codes and brought the system in-house. It used the system about 30 years ago and has kept it current since its inception. A similar experience was shared by the head of the customs brokerage company, which owned the code, allowed flexibility, and increased employee productivity. Owning their systems allowed these organizations to enhance and adjust to increase their competitive advantage. While most organizations develop their systems, most augment that proprietary system's capabilities with other systems to perform non-core organizational functions.

Firms that do not use proprietary systems instead use what one respondent referred to as a "store-bought" system—that is, software that has been developed and is available in the market. While the software developers manage and enhance these systems, they also allow providers to customize them based on their processes or specific client requests. Most respondents claim these systems improved their internal productivity and streamlined their processes. The study responses show that proprietary or nonproprietary smart technologies increase a firm's productivity. Not only do these technologies enable operational functions, but they also typically support administrative processes.

The more common administrative processes are for data exchange and information flow, which is critical to initiate operational processes and provide customer visibility into the activities of goods that providers handle on their behalf. Data accuracy is a critical factor that impacts all providers' functions. Inaccuracy causes physical delays and supply chain risks—or worse, financial penalties to one or both organizations. Inaccuracy impacts the contractual obligations of providers' intermediaries, customers' vendors, suppliers, customers, finance partners, and government agencies. Data accuracy seems to be a consequence of technology adoption. Still, my findings show that providers consider accurate data a requirement for managing their operational and administrative processes, thus driving process transformations. As a respondent from a newer company in Mexico City shared, "*China documents need manual quality checks… even with integration, there are still mistakes—a case of lost in translation."*

IV.1.3 Financial Pressure

Smart technology adoption allows logistics providers to be innovative. It allows them to streamline and improve their processes, which translates into the service quality that customers perceive as value. Despite this, most providers constantly feel pressure to improve bottom-line

growth. These firms continue to invest in technology to support financial success by increasing revenue or reducing costs. As the literature posits, such investments are costly for organizations.

Of my respondents, 27 said that cost reduction is the biggest challenge in their organizations and that smart technology adoption is expected to support it. Existing market demands require process transformation, increasing these firms' capital and operational expenditures. In addition, the cost of technology and its adoption are required, which increases costs for firms. However, firms also expect technology to replace the increasing cost of manual labor and the scarcity of human resources for blue-collar work. However, the changing workforce and the availability of skilled resources increase providers' staffing costs. Sophisticated systems require technologically adept employees, which are scarce in the current marketplace. Providers also mentioned that retaining talent is another challenge besides attracting the right talent. Sourcing, hiring, onboarding, and training for staff that leave the organization before realizing the return equates to additional costs. According to one respondent, who co-founded their firm 13 years ago, a labor shortage, including for middle management and administrative staff, has occurred in the past ten years. He added that the recent pandemic exacerbated this issue as the disruption exaggerated existing issues in supply chains.

As the CEO of a warehousing and distribution company offering services, his company *"has the vision to scale the company from where it is today—over the next couple of years, to do a substantial scale."* As the market grows with globalization and eCommerce, providers are expected to scale labor, capacity, and infrastructure to reduce costs. Capacity and infrastructure are typically addressed through the ability of smart technologies such as AI and machine learning to forecast the organization's demands. These technologies also aid in demand and labor planning to help address shortages and mitigate potential issues.

A senior vice president in charge of business development mentioned that finding the balance between technology and customer service is still challenging. In addition to the investments, smart technology adoption has unique challenges for companies. Its adoption affects other entities in customers' supply chains, complicating its integration. Not all entities are willing to adjust their existing processes for providers. The process alterations incur additional company costs for providers, who must run parallel processes to avoid disrupting their operations. Further, using chatbots and robotics does not permit operations personnel to exercise the customer service levels that customers expect. Companies, therefore, continue to require customer-oriented personnel and quality checks to support customer-facing functions.

Maintaining profitability while offering services at certain thresholds becomes a double-edged sword. Increasing revenue requires providers to leverage their competitive advantage to retain existing customers and generate a share-of-wallet while using it to attract new customers. In this highly competitive industry, price difference preempts the loss of opportunity to win new business. While providers recognize revenue by retaining existing customers and attracting new ones, they must consider the amount of investment in the technology itself and its adoption. Literature on smart technology adoption is limited to improving performance and reducing costs.

IV.2 External Drivers

IV.2.1 Technological Advancements

The availability of technology and its rapid development has positive and negative effects on providers' firms. On the one hand, they select what is best for their operations to benefit their customers. On the other hand, advancement in smart technologies increases daily. In addition to new technologies, there is an endless supply of enhancements to the existing technologies in the market today. Whether they offer niche services or full-service logistics offerings with a wide

array of upstream and downstream activities, most providers use multiple smart technologies to manage the business for their customers. The multitude of smart technology options provides availability in selecting systems and tools and helps firms with resource management—including financial, human, and time management.

Figure 9 provides an illustration that maps the types and usages of smart technology available to providers. Technology primarily benefits providers' business operations. Most systems have multiple uses, but providers primarily leverage them to handle physical activities such as order management and fulfillment, storage processes, and shipment preparation for distribution. These tools used in operations typically support administrative processes. The more common administrative processes are for data exchange and information flow, which is critical to initiate operational processes and provide clients with visibility into the activities of goods that providers handle on their behalf. Most of these systems also allow report generation and other critical components of managing processes for providers' customers and their customers' clients. RPA is frequently implemented to support the administrative requirement to handle a massive amount of information, which goes beyond the provider and their customers to other actors in the supply chain. These actors include government offices and agencies for customs processes, federal agency requirements, and industry regulatory bodies. Technological advancements allow the smooth flow of data exchange between parties in the supply chain network without having to send physical documents. They also provide seamless coordination and communication. The CEO of another U.S.-based full-service provider said, "*We are connected to our carriers. We don't have to make those phone calls, and we get that information back. And it's 99% accurate. It just flows so that it flows into our operating system and again into our customer dashboard*."

IV.2.2 Increasing Competition

Literature posits the emergence of disruptors and the new competition in logistics outsourcing, yet my findings do not substantiate this notion. Instead, providers note that the emergence of disruptors simply added a layer of processes for customers. According to the CEO of a U.S.-based contract logistics company that offers warehousing and distribution services, "*We play in different fields, have different customers—they have smaller ones, and we have the large ones who prefer customized services."* Some providers mentioned that disruptors support their customers, eliminating the previously required coordination. These firms do not consider disruptors as competition but rather see them as supporting specific processes in their core competency. Further, they consider them an added layer that supports both the customers and the providers.

IV.2.3 Supply Chain Disruptions

Contrary to the literature findings, my interviewees do not associate their firms' smart technology adoption with supply chain disruptions. Most mentioned that disruptions are external and are handled as "business as usual." My interpretation of the data gave the impression that providers have been inundated with supply chain disruptions. The recent COVID-19 pandemic may have been a nuisance to most businesses and consumers alike, but disruptions occur regularly and are more prevalent for companies involved in or using global processes. In a typical logistics environment, external factors—from the most isolated, singular issue to a global event—create a chain reaction of issues affecting one interdependent factor after another. These issues create impacts ranging from a single isolated transactional activity to an entire logistical process impacting the organization's supply chain. Recent disruptions include the eruption of the Eyjafjallajokull volcano in 2010, the Japanese Earthquake and Tsunami in 2011, Hurricane

Sandy in 2012, terrorism attacks in 2015, the 2019 protests in Hong Kong, and the China–U.S. trade war in 2020. Also, as economists have been forecasting since 2021, the effects of the COVID-19 pandemic will persist through 2023. Technological advancements, such as AI/machine learning, RPA, and digital twins, allow logistics providers to manage data and give customers visibility into how their operations are being managed. Prescriptive analytics can help alleviate disruption-related bottlenecks for logistics providers and support their customers' supply chain resilience.

IV.2.4 Industry Fragmentation

Smart technologies are critical to providers' process transformation to reduce errors and increase data accuracy. Due to the global nature of processes, fragmented supply chain networks face increasing problems with data when operating across mountains and oceans. Customers demand that data be accurate as it aids in decision-making. Information transfer is vital for the supply chain network to proceed from one step to another; otherwise, the supply chain breaks. Disentangling the supply chain can provoke network actors to make proactive, immediate decisions when issues occur. Some respondents stated that the technologies support decision-making through AI and machine learning. One respondent from a Europe-based company said that AI and machine learning helped predict global volumes, track information on shipments from origins and destinations worldwide, predict capacity requirements and forecast financial results. He added that IoT data provides real-time information on temperature, light, humidity, shock, and other variables necessary to maintain the sensitive commodities that his company ships for customers on air and ocean freight modes around the globe.

While fragmentation in the supply chain is a well-known fact, most literature on the topic is narrow, focusing either on manufacturers or recipients of logistics' upstream and downstream

processes. Literature and business publications provide specific technologies based on specific business functions such as procurement, environmental and social governance, compliance, finance, etc. Regarding logistics providers and the effects of fragmentation on their business, the literature recommends using blockchain technology to allow intermediaries and avoid data vulnerabilities that impact supply chain technology. However, the implementation of blockchain technology has proven to be ineffective. One of my interviewees stated that the industry is still in the infancy regarding blockchain; Maersk's decision to terminate its blockchain technology, which linked more than 300 intermediaries, indicates how ineffective the technology proved. (Maersk, 2022).

Other smart technology applications, usually integrated by EDI and API, contributed to these challenges. A U.S. contract logistics and distribution company executive mentioned that technology allowed their company to secure important documentation from their intermediaries for billing purposes, thus improving the firm's cash conversion cycles. As another executive uttered during the interview, "*We are rowing the boat in the same direction."*

IV.3 Consequences

My findings suggest that smart technology adoption impacts providers' firm value. It validates prior studies showing that such adoption reaps positive results for a firm and thus increases its value. In analyzing the rich data from 40 respondents, I also identify the consequences of this adoption in practice; these consequences involve both people and processes, which aligns with the literature.

Previous research states that smart technology adoption impacts human resources by improving the existing skills of current resources while also requiring new competencies. Existing skills include the industry experience that employees have gained over time. However,

some employees lack competency in managing and operating new technologies to supplement their skills. As a result, these new technologies require new competencies, and combining the old and new skills is expected to benefit provider organizations.

IV.4 Impact on People

Adopting technologies enhances human resource capabilities by improving employees' skills, adding competencies, and increasing productivity. It is a known fact in various industries that outsourced logistics is a "people business." Provider firms' leaders are aware that smart technologies are expected to take over the human element in supply chains, yet they also understand that people remain their companies' biggest assets. The 13 C-level executives in my study confirmed this concept of cyber-physical systems.

IV.4.1 Enhances Quality of Work

The gap in workforce culture plays a significant role in adopting new technologies. Companies typically require experience in both operational and managerial functions. Managing logistical processes is, by nature, evidence-based. Situational assessments require heuristics combined with experiences due to the urgency and consequences that may result if issues that arise are not immediately addressed. The nature of the business requires critical skills and decision-making speed brought about by experience in practice. A firm's more experienced workers come from a different generation of employees. These workers are usually not adept at agile processes and are less technologically dependent than younger employees.

My interviewees shared that smart technology adoption added complexities in managing human resources. In trying to develop the skills of current workers, they often experience resistance to changes both in the technology and the processes they enable. The U.S.-based company's CEO said, "*It was a hard one because people just, you know, they couldn't let go of*

their system." A few others also identified resistance to change as a common trend in their existing labor force. Replacing existing workers with a new breed of workers creates both operational and legal challenges for firms. Providers must also contend with union workers, which is inevitable in certain states.

However, the contribution of existing employees is invaluable as well. They bring knowledge about and experience in the industry that helps them maneuver through issues and disruptions from external events. They are also familiar with the company's culture and have no learning curve when maneuvering the internal organization's demands and challenges. Furthermore, most companies have employees working there since the company was founded. As one senior executive stated, "*The loyalty of these staff is priceless*."

Respondents claim that there is always resistance to change; this resistance increases adoption costs due to the need for training and increases errors in the initial implementation phase. Further, the labor reductions that smart technologies were expected to create were not realized in the short term. Some companies anticipating increased efficiency resulting from implementing new systems incurred additional overtime costs after eliminating a certain number of employees. As one respondent put it, adoption can actually *"incur additional cost for labor [as] we need to make up for the inability of technology.*"

Most interviewees said their firms found that the change required to manage technology adoption entailed a cost. Existing employees are either excited about technology (as they anticipate it as a benefit) or assume that the technology will replace their jobs. The latter are harder to train, according to the respondents. Companies use different approaches to address the required changes for employees to understand the technology's benefits. Some used a top-down approach, with information disseminated from top leadership to operational leadership and on

down before adoption. Others started with back offices or administrative functions before the front-line operations teams to show the technology's effect. Although the market includes highly efficient technologies, their adoption necessitates additional skill sets, yet firms also need current employees' industry experience, so eliminating them was not an option.

IV.4.2 Increased New Competencies

Given the capabilities needed to manage and run the technologies in warehouse locations and offices, some companies paid to recruit new talent. To manage this balancing act of adopting new processes and transforming older but usable technologies, providers created teams to handle training and coaching for existing and new employees. A niche provider added a Project Management department to manage the deployment of internal and customer technologies. A representative of another firm stated that the newly created Project Management department maximized their firm's resources during adoption. Another provider created a well-rounded internal group to "*go from training to recruiting, hiring to firing, to marketing analysis*," which worked well. As that sales leader commented, "*The process is good."* In contrast, a smaller organization built leadership technology teams for each unit to manage the transition. Managing across talent bases, including existing employees and recruits, incurs additional costs.

The respondents in my study agreed that additional human resources are needed during technology implementation. Whether these are implemented by outsourced parties who build teams to support the organization or by creating new teams within their organization to handle it themselves, there is a learning curve requiring training and education that is prone to errors and redundant processes during its implementation. Therefore, as my findings show, smart technology adoption indeed incurs additional human resources costs for these firms, on top of the investments in hardware and software and the integration with existing systems and processes.

However, the skills required in these technologies may incur significant labor costs that are added to providers' operating costs.

IV.4.3 Productivity Improvement

Most providers recognized the need for technological innovation. They continued to invest in applications and hardware to support the potential shortages that may recur as part of normal business operations. Hence, as a warehousing and distribution CEO uttered during the interview, "*handhelds and applications that could digitize documentation and give point-to-point directives, provide load planning on their handhelds; so we implemented that as well to reduce the keystrokes and the manual input*." Some providers claimed it takes years to get a new system running smoothly and have employees feel comfortable with its functionality.

Implementing technology reduced the cost of labor for most respondents. However, some providers and customers have an "open book" price agreement, which is an added percentage to the total cost of operations. Hence, that agreement reduced the overall revenue the firm may have achieved due to the lower labor costs.

Companies need to create a workforce with both experienced employees and employees from newer generations. However, doing so is a balancing act that their management needs to address. One U.S. CEO in our study shared, "*We try to provide really good technology so they're not fighting with technology. I think that's really frustrating for the younger generations who've grown up with great technology. Just that technology is second nature to them."*

Enhancing existing and new technologies requires process transformation and different personnel skill sets. Such technological advancements also require systems integration, particularly for most providers still using their existing technologies. One provider that offers technology-driven truck brokerage services stated, "*You work in parallel for a significant period,*

and even for an upgrade on the same platform, you would have an enormous amount of focus from the PMO (Project Management Organization) team, the engineering team, the software engineering team, and the data team." The sales manager in India for a top global full-service provider said that running parallel implementation requires a trial-and-error approach, which requires economies of scale and resources that the respondent's firm has, but many other organizations lack.

Another respondent is from a company comprising 19 mergers and acquisitions. The company uses 32 systems for its operations processes alone. For customers to enjoy single visibility, the firm adopted a new platform that houses all data from multiple systems. Integrating these platforms will require the firm to transfer data for history and analytics while simultaneously running its operations. According to the respondent, a senior vice president for the firm's healthcare vertical, the decision to integrate delays the larger systems integration into one platform, which could be a three- to five-year plan. Most respondents argued that the need for traditional systems and processes remains despite adding automated systems to run operations. Not all systems are user-friendly and reconfigurable. As a result, firms are forced to utilize other technologies as a go-between to manage both systems. As one respondent noted, "*It becomes technology over technology to have the systems fully functioning*.", referring to technology stacks added to their organization.

The constant enhancement of providers' systems becomes a vicious cycle of employee adjustments. On top of this, employees in operations, administrative, and managerial functions all must adjust their processes. Implementing new technologies is even more disruptive, requiring integration with customers' systems and intermediaries. Take the case of DHL, for example. In 2013, to implement a replacement for its legacy Logis system—a patchwork of IT

systems acquired by various companies across 30 years—, DHL launched a new system using a phased rollout (*Getting I.T. Right: What Forwarders Can Learn from DHL's Struggle | Air Cargo World*, n.d.) The highly publicized, ill-fated new system was launched as part of DHL's modernization plan and was designed with SAP and IBM. It cost DHL nearly US$1 billion and was scrapped in 2015, with a €345 million write-off (*SAP: Don't Blame Us for DHL's Logistics Woes | Computerworld*, n.d.).

IV.5 Impact on Processes

IV.5.1 Reduces Complexities

While prior research presented the positive impact of smart technology adoption during disruptions, as evident during the COVID-19 pandemic (Przhedetskaya et al. 2021), my research showed no such direct, positive impact on logistics providers. Nonetheless, providers must support their customers' resiliency in the face of such disruptions. Social distancing required in most companies during the last global disruption exacerbated the challenges of running supply chain operations for providers, particularly in warehousing operations. Smart technologies gave providers visibility and augmented their shortages in human labor, helping the companies to continue normal business operations.

Smart technologies also gave providers the flexibility they needed to scale their operations when human resource shortages arose, and the volume of business upsurged during COVID. One participant noted that providers had even "*taken on the slack*" when retailers started giving out furloughs to their employees. One retailer left one person to handle the operations of inbound supply chain activities from hundreds of vendors worldwide. As supply chain partners, the provider became an extension of this retailer's departments, handling supply chain and logistics processes on their behalf.

Most of the providers in this study provide upstream and downstream processes. Activities they manage include transportation management; international freight forwarding (airfreight, ocean freight, rail, or multi-modal); freight brokerage; parcel delivery; domestic trucking services (full and loose truckload); warehousing; transportation brokerage; customs brokerage; fulfillment; distribution—including omnichannel and returns management; white glove home delivery; and eCommerce activities. In addition, some providers perform administrative processes such as audits, financial management, real estate management, port services, and other customizations related to logistics processes. Each activity requires certain standards, but some offer customization to accommodate specific customer requirements. Most of these standards are measured through KPIs or metrics organizations use to assess against defined standards. Such metrics allow providers to gauge their employees' productivity internally. Hence, productivity is measured according to standards that firms identify to hold their employees accountable or to indicators that customers prescribe as part of their agreement.

Of the 40 companies in my study, 16 said that the major impact of smart technology adoption in their operational processes is increased speed and accuracy. eCommerce's evolution increased consumer delivery expectations, as Amazon initiated next-day and then same-day delivery. Covid-19 made consumers realize that goods can be at their doorsteps within hours given a certain proximity. Besides the speed, it is crucial to ensure accuracy in actual commodity and shipment information to avoid compromising the delivery window. Otherwise, any error caused will result in delay and jeopardize a provider's commitment to their customers and their customer's customers. Speed and accuracy also extend to customers' expectations of receiving information. Smart technologies enabled this, with faster data processing provided through AI/machine learning and the integration of supply chain network connections for visibility. One

respondent said that technology improved their performance by allowing them to focus on the impact of such improvements on customers, including a "*huge improvement in securing documentation for billing purposes and faster customer service—from a customer service perspective, quicker answers, more time working with clients*." Some providers claimed that reducing manual processes through technology adoption and data automation enabled faster processing time. Smart technologies also made processes repeatable, reducing errors and improving cash conversion cycles.

Performance improvement and productivity are also by-products of streamlined processes and systems integration. These factors benefited 17 providers in the study. Better integration eliminated the patchwork of systems previously used by one provider, who said that "*those systems were very labor intensive and prone to break."* However, three respondents noted that integrating systems was a tedious process. An executive from a multinational courier company said that issues became known only outside the testing environment. Another comment from an operations head of a company in China said that their teams do not realize any benefit because they still need to perform quality checks after the technology completes the process. Yet another executive stated that, despite the integration, their company still operated on hybrid processes, necessitating manual work to support technology, such as using optical character recognition software that reduced keystrokes in the computer for data sent manually.

Using smart technologies to streamline processes through centralization and standardization resulted in process uniformity or, as one described it, *generic processes*. Process standardization is useful for collaboration and reduces manual processes for employees, who can then focus on value-added activities such as customer service and quality checks that increase

productivity. Whether centralized or fragmented, process changes require time and training, incurring additional costs for organizations.

Most global companies in my study said these technologies enabled top-down productivity. For the CIO of one of the top global 3PLs, technology enables the managers to review processes daily for immediate performance improvement. Another global company's vice president of Latin America strategy agreed: "*Little improvements that can be easily adopted are more effective in managing productivity than big changes at one time*." The business development director of another global organization attributes smart technologies' ability to enable *customer profiling,* which identifies the types of processes needed to guide new business implementations.

IV.5.2 Improved Shipment and Inventory Visibility

Visibility is a vital component of the service offering to logistics provider customers, enabling them to serve their customers better. Smart technologies provide visibility into supply chain flows, from raw materials to the distribution of goods. Empirical evidence in previous studies proves that smart technology adoption in supply chains mediates digital and physical process transformations (Chung). These recently developed technologies in logistics processes help businesses to manage activities to deliver value to their customers (Tripathi, 2020). Logistics processes are composed of upstream and downstream activities. Evolving market demands globally have added to these complex activities' requirements for increased speed, agility, and visibility. The interconnectedness that smart technologies allow benefits the many organizations that makeup today's supply chains.

Upstream processes include the flow of items from producers, suppliers, or vendors of raw materials or products for manufacture, sub-manufacture, or assembly into finished goods.

Downstream processes involve delivering products or their components for ultimate consumption by businesses or consumers. However, globalization made supply chains susceptible to disruptions. Visibility into disruptive changes in the supply chain allows faster decision-making and supports supply chain resiliency. The connectivity between customer and provider systems enables better visibility that adds customer value. From the perspective of the U.S. regional director of operations of a global provider headquartered in Europe, such visibility facilitates global reporting, *"staying on top of the track and trace the systems, being able to provide reporting that the customers want."*

One respondent, who leads the U.S. sales department of a leading global freight-forwarding company, offered a sales perspective: "*It's all about getting more technology into the customer's hands, and you know how it is when you can get them tied in with that*" (referring to the stickiness of customer relationships). Some customers relinquish the responsibility for faster decision planning due to familiarity with their businesses as an extension of their supply chains. When providers' operating platforms, such as WMS, TMS, and others, are integrated with customers' enterprise resource planning systems, it guides providers. Finding immediate resolutions to problems is particularly useful during disruptions and supports supply chain resiliency.

Smart technologies also reduce the manual intervention and hardware previously required. One respondent attested to this, noting that previously, "*They (resources) would need four monitors on their desk. So that's where it* (the process change) *got a little bit challenging for us*." Streamlining the visibility of internal operations allowed providers to communicate better across the organization and contributed to employee productivity. It also simplified functions for better decision-making and allowed an agnostic view of customer activities, letting employees

respond immediately to customers and other supply chain actors. Network collaboration is the consequence of visibility. While visibility and network collaboration go hand in hand, visibility gives providers better internal processes and decision-making ability.

Visibility improves firm performance and supports a company's resilience through faster decision-making. Implementing this speed in provider decision-making is critical to support their customers' resilience. In addition to customer benefits, visibility improves the provider's organizational performance and productivity. Smart technologies allow providers to track the intermediaries they employ to ensure they deliver customer services as expected. A respondent from a company headquartered in Hong Kong said, "*We also utilize some other technologies where like, if we send out a truck, we put a GPS device in the truck, so we kind of know when it's delivered, and that automatically feeds into the system*." A respondent from a U.S.-based company stated that its internal visibility "…*flows into our operating system and again into our customer dashboard.*" One respondent noted that newer technology offers better visibility that enabled their firm to map carrier routes, which is critical to managing customer expectations and costs. Visibility also helps providers to minimize disruptions.

IV.5.3 Fostered Better Network Collaboration

Prior research shows that smart technologies enable better collaboration and visibility among participants in the supply chain network. Providers with newer technologies provide accurate data availability that links actors' activities in one platform through interconnections with other supply chain intermediaries. As one respondent stated, "*We are connected to our carriers. We don't have to make those phone calls, and we get that information back. And it's 99% accurate*." This reduces the steps typical of providers who are slow to adopt technological changes—that is, firms where coordination requires email exchange, phone conversations, and,

worse yet, requiring employees to physically commute to gather information directly from intermediaries.

Not all customers adjust their processes, however. Some respondents claim that customers sometimes communicate and send documents via email, despite providers' asking them to use a new system. Aside from requiring a paradigm shift for customers, some customers do not have the resources to integrate with their providers' systems. Customers are also cautious about causing ripple effects that might disrupt their own operations because of potential cyber security threats as literature posits. Our respondents did not mention this as a risk during the interviews.

Network collaboration extends beyond the provider and customer to other supply chain network actors as well. For example, providers use technologies to integrate with government customs systems, such as the U.S. Customs and Border Protection's ACE (Automated Customs Environment) Portal that supports import and export admission processes to and from the U.S. to facilitate the country's efficient exchange of goods globally. The portal allows customs brokers to either supply chain intermediaries for providers or in-house services that providers offer customers. The portal simplifies documentation and communication exchanges previously managed manually through email correspondence or phone conversations. The portal also processes payments for customs duties, taxes, and other charges, eliminating the need for hand-delivered physical checks to various customs offices. The acceptance of customs entries and other comments that expedite trade processing provides visibility to providers and customers, allowing immediate resolution or decisions for any issues.

Technology positively impacts network collaboration, which is critical to providers' business operations. One of the respondents realized this benefit when their parent company

allowed their division to operate as a separate business unit. Their business unit was then able to develop its own system, which employs machine learning algorithms to price, coordinate, and map customer routings and communicate with truckers and courier companies contracted to deliver services for middle- and last-mile deliveries.

However, while managing these processes, the firms incur additional administrative tasks due to the manual processes of other supply chain actors. While technology allows better visibility needed for collaboration, some intermediaries still require manual coordination. The data also mandates quality checks to avoid issues that will hamper delivery logistics services.

IV.6 Smart Technology Adoption Moderators

My research findings identified factors that positively or negatively impact logistics providers' smart technology adoption. These factors emerged from the data, as my choice of research participants was not contingent on these variables. My data analysis and interpretation allowed these factors to emanate and provide better context based on the organization's tenure. I define it as the number of years the company has existed in the outsourced logistics industry. Its financial capacity, identified based on the revenue size or valuation of the firm (which is sometimes dependent on company ownership); and the length of the customer relationship, since this may incur the loss of business if the providers' technological adoption negatively impacts their logistics operations and network relationships.

IV.6.1 Business Tenure

Company evolution creates another problem: many providers run multiple systems. Some providers operate on various systems due to structural changes and need to integrate the systems for singular visibility. Once integrated, the system enhances productivity. Otherwise, the firms require another system to host these multiple systems and avoid redundant steps for customers

and employees to access them for data generation and visibility. Multiple systems also create a lack of uniformity in data, making consolidation for reporting and decision-making laborious. Among my study respondents, 50% of the firms have existed for more than 50 years. They were thus launched in the second or third industrial revolution when information technology was not yet a critical part of their processes. Six of the remaining firms were established in the past 40–50 years when the industrial revolution's link to supply chain technology—established in 1968—emerged and was dubbed the "Systems of Logistics Management" (Ezzat et al., 2019). Another six providers began operating over the past 30 years; during these pertinent decades, providers began implementing operation-support technologies, such as the Electronic Data Interchange and, in the 1990s, RFIDs, and barcodes. The widespread use of technology in logistics became rampant during the Fourth Industrial Revolution, or Industry 4.0, beginning in 2011. The remaining eight companies were established in the past ten years when the constant need to keep up with market demands allowed their structures to evolve more readily. All the companies in the study evolved in various ways. Among them, 24 firms—or 55% of those in the study—evolved by adding new products, services, or solutions to their service offerings. As one respondent shared during the interview, "*We have some folks that are quite advanced in their ability to analyze supply chains and come up with other solutions that others just don't see*." Adding new products required five of those 24 companies to undergo complete diversification. Some of their unique diversification strategies included establishing a new company as a spin-off from their parent company, specializing in specific market segments, or focusing on specific customer profiles; in two other cases, the companies physically expanded to other geographies.

Practitioners who participated in my study included a heterogenous combination of new and mature companies. To summarize the characteristics of these companies, half of the

providers have existed in the market for more than 30 years. Some have operated businesses since the first industrial revolution and have adopted technologies over time. Literature shows that companies that have existed for several decades and followed the industrial revolution's evolution needed to constantly adopt new technologies to maintain their competitive advantage and manage evolving market trends (Oleskow-Szlapka et al., 2018). Past technologies are associated with processes they enabled, and every change impacted incumbent processes, requiring process transformation. This business evolution also required them to train and re-train their human resources to manage and operate newer and better technologies.

Most companies added products and services to be considered full-service logistics providers. Full-service providers offer a wide range of services that either complement their core service or are standalone offerings. These companies often evolve through mergers and acquisitions, expanding their service offerings, diversifying businesses, and extending services in different geographies. A growing trend in the outsourced logistics industry is for firms to grow through mergers and acquisitions. Providers must consistently transform processes to keep up with the changing market demands, whether their evolution is characterized by new products, services, solutions, a diversification strategy to focus on a market segment, a specific offering, expansion to a new geography, or mergers and acquisitions. Even firms established within the past ten years with technologically driven processes continuously enhance their organizational processes. As the CEO of one of these companies explained, "*We are always looking for either a service, a geography, a set of customers, or technology that augment the company's capabilities.*"

In my study, 14 companies reached their current structure through acquisition, with the goal being to focus on specific services or geographies or add the services to the acquirer's

company. Changes in these companies' processes due to their structure evolution required transformation. According to respondents, smart technologies allowed acquisition speed and improved dynamic variables.

Most respondents identified business requirements as they evolved into their current structures. Smart technologies supported these companies in augmenting their resources and eliminating identified redundancies by combining capabilities. They typically allow old and new technologies to run parallel to streamline processes during the organizational integration while gradually terminating systems that do not meet the process.

One company, for example, was started by a freight audit employee 30 years ago. Over time, the business grew with expanded service offerings in cost management, supply chain optimization, and managed transportation services. As the company grew in size and service offerings, it had to divide into business units to focus on its core offering. Yet, the business continues to operate under a single entity. With this expansion and contraction, businesses like this adopt and reduce technologies according to their needs. My research findings show that mergers and acquisitions in this industry are a means of growth. Of my 40 respondents' firms, 15 reached their current business status by either acquiring or being acquired by other companies.

Interestingly, one of the companies has a unique business model of acquiring small companies without integrating people, processes, or technology. The company started in the 1980s and had acquired 19 other companies by 2022, and it continues with this acquisition strategy today. The companies it acquires continue to operate independently and are allowed to grow on their terms.

Six other companies opted to diversify by spinning off business units and product lines to concentrate on specific—and typically more profitable products and services. One of the

respondents is from a U.S.-based multinational trucking company, which another company acquired in the 1990s to support its global warehousing and distribution offerings. Since 2020, the company has decided to spin off different business segments into international freight forwarding, warehousing and distribution, and domestic trucking operations worldwide. It allows these businesses to operate independently and for each business unit to focus on its service offerings.

Given the speed of technological advancements, the same case also occurred in companies that began operating over the past 10–20 years. These companies have less exposure to older technologies, but the evolution of smart technologies over the past decade still requires updating past technologies. Market demands, agile processes, and scalability also prompted these organizations to adopt innovations. The eight respondents from companies established over the past 10 years started with concentrated technology-enabled service offerings. They did not carry excess baggage of incumbent processes, existing resources, and antiquated technologies that required a complete overhaul. Processes and technologies are harder to adjust because most are integrated with customers and other actors in the supply chain, which requires all actors to make the changes as well. Hence, this increases not only providers' operating costs but the cost of adoption as well. However, providers can also be limited by too narrow a focus of their service offerings. Some companies offer niche services, such as warehousing and fulfillment, eCommerce order management and fulfillment, customs brokerage, or logistics management. Despite the focus on a single core product—which more often is supported by non-core products that these companies manage by themselves or outsource to other providers or intermediaries—the 11 niche companies in my study have existed for more than ten years and thus have excess baggage similar to that of full-service providers.

The existence of businesses over time, rather than the type of services offered, moderates the impact of smart technology adoption. Older companies have more challenges with their existing technologies than their newer competitors. Yet, despite being more agile and quick to transition to newer technological trends, newer competitors encounter other challenges, such as scalability and product expansion.

IV.6.2 Financial Capacity

My research has limitations in determining a common measure to compare the size and scale of participants' firms. Some of these companies are privately owned as family-run businesses (7) or are managed under private equity or venture capital companies (22). Financial status is available for 11 of the 40 companies represented, but this does not offer a common measure to determine their size. For a more constant assessment of the firm's financial capacity, which may moderate smart technology adoption, I requested five-year annual gross revenues for the companies through 2019. I chose 2019 as the endpoint to avoid the logistics market volatility during the COVID-19 pandemic, from 2020 to 2022, when these organizations' revenues fluctuated outside of normal and historical ranges (Atayah et al., 2022).

My initial assumption that larger companies have greater financial capabilities to adopt smart technologies with fewer challenges is inconclusive in this research. For purposes of research comparison, in terms of the size of the 11 companies, I considered those with average annual gross revenues globally of below US$100 million as *small*, those with revenues of US$100million up to US$1 billion as *medium-sized*, and with those generating revenues of more than US$1 billion as *large*. While these are gross revenues, it represents providers' size and scale. Larger companies offer more services and are typically bigger in size and scope. Size and

scope equate to the existing processes and resources, which may positively or negatively impact technology adoption.

As the cases of DHL and Maersk presented earlier show, a company's financial capacity does not determine the success of its technology adoption. DHL and Maersk are two of the larger players in the industry: DHL is a provider, and Maersk is a subsidiary that most providers use to handle global ocean freight. It took four years for each company to recognize the negative impact of technology adoption, following huge financial investments in the people, processes, and technology itself.

Regardless of the firm size and financial capacity of these organizations, it is inevitable for them

IV.6.3 Length of Customer Relationships

My research findings show that customer value is a driver rather than a consequence of smart technology adoption. Providers exist based on the value their customers perceive, which is evident in the length of relationships in my research. The firms that participated in my research boast more than thirty years of customer relationships. Most of these companies existed concurrent with their providers, with a few existing even before the first industrial revolution. Six other companies have 20–30-year customer relationships, nine firms have 10–19-year customer relationships and newer companies have had customers with them since they started their businesses. Given that 18 respondents, or nearly half, associate this relationship longevity with knowledge of the client business and 11 associate it with the quality of services they deliver, I found a linear relationship between customer tenure and the value delivered due to the integrated nature of supply chain processes.

The length of customer relationships prevails while their business needs are continuously satisfied, and they consistently realize the value of the services provided to them. Successful providers ensure that their services evolve with the customers' business needs. Hence, smart technology adoption is congruent with the speed of manufacturing and production and changes in consumer demands. As the latter changes over time, providers must innovate and adopt new technologies based on customer demands. Some customers willingly share the investment in technology to continue their provider partnerships as an extension of their supply chains. While the newer companies were established over the past ten years after the inception of Logistics 4.0, the speed of technological advancement continues to enhance their systems. Given these findings, my research shows that the length of customer relationships moderates providers' smart technology adoption. Almost half of the respondents associate relationship longevity with greater knowledge of the client's business or a more intimate relationship with clients. A few respondents said that retaining account management teams generates better knowledge by focusing on the clients' business. It also allows transparency in exchanging information that is useful to create strategies and solutions. The CEO of another company stated, "*We do business the old-fashioned way. We do business on a handshake. If we say we're going to do something, we do it.*" Personal relationships still exist in this industry. With personalization comes knowledge about the company and the actors within it. Relationships allow the providers to improve their processes according to the customer's requirements and collaborate to attain service quality.

IV.6.4 Summary

To better illustrate my research findings, Figure 10 presents concepts that emerged from my thematic analysis of the data. Comparing this diagram to the conceptual framework shows

that our data presented more positive and negative performance implications than most literature ignored.

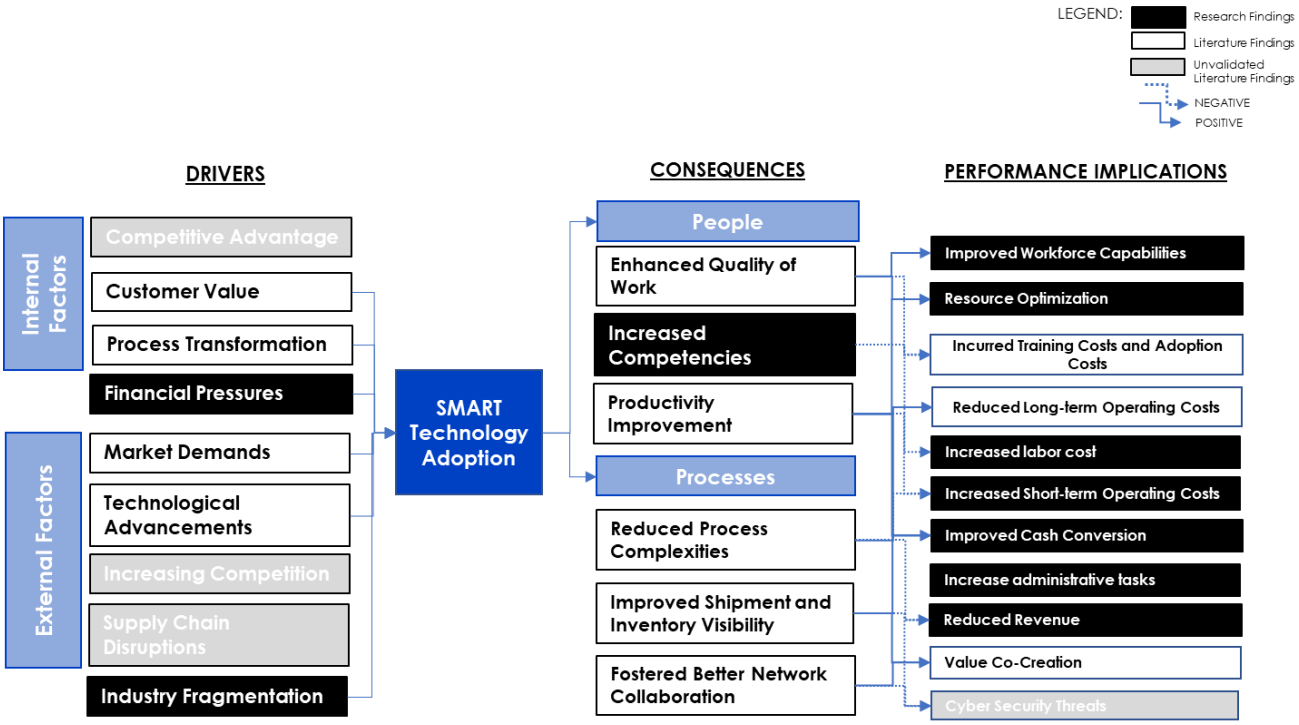

Figure 10 Research Findings

IV.7 Theoretical Implications

Although a novel in academic literature, smart technology adoption is now widely recognized as an important topic. While it was originally used to generalize the concept of *smart structures*, the term *smart technology* has been adopted for applications that enhance the natural capabilities of users. It first gained momentum when these technologies were implemented in homes; then, with rapid technological advancements, its definition evolved into a general term that involves the IoT, Big Data, AI, and machine learning (Cimini et al., 2020a; Nasiri et al., 2020). For providers, the supply chain is one of the main industry functions transformed by integrating smart technologies. The logistics aspects of the supply chain impact a firm's ability to create and deliver products and services. Given the complexity of modern supply chains, smart

technologies address challenges and are critical in the performance of these organizations in global business settings (G. Zhang et al., 2022). Adopting smart technologies links digital processes among participants in the supply chain network involved in either upstream or downstream activities and firm performance (Alkhatib, 2017; AlMulhim, 2021). Smart technologies, through IoT adoption, allow seamless integration of providers' logistics processes to the overall supply chain operations of customer firms (de Vass et al., 2018) and contribute to their resilience and optimization (Atwani et al., 2022). In addition, smart technologies provide a level of transparency and visibility by improving tracking and monitoring processes, enhancing the experiences of businesses and their customers (Akkaya & Kaya, 2019; Kalkha et al., 2023).

Industry 4.0 increasingly necessitated the development of Logistics 4.0 so that providers could adopt smart technologies to keep up with market demands for speed, agility, and flexibility (Cimini et al., 2020b; DOUAIOUI et al., 2018; Galindo, 2016; Oleskow-Szlapka et al., 2018), While the literature on the drivers and consequences of smart technology adoption exists, most of it focuses on its contribution to firm value. As Chapter 2 describes, the systems and applications that smart technology enables include warehouse functions improvement through the use of AI (Nasiri et al., 2020; Pandian, 2019; Žunić et al., 2018); blockchain technology that impacts business-to-consumer (B2C) eCommerce transactions in global networks by offering data security from order fulfillment to payment processing (Ahmad et al., 2021; Nadeem et al., 2019; Zakharkina et al., 2022); and robotics and automation for collaboration in cyber-physical spaces, which is critical for distribution process of downstream logistics activities (Jagtap et al., 2020). Chapter 2 also describes the availability of ubiquitous tools that smart technologies enable. However, given the constraints of existing literature, there is a wide gap in terms of providers' adoption and prioritization of resources. Most of the articles I found were limited to

providers' customers (manufacturers, distributors, and retailers). While such discussions are vital to improving provider performance, few articles discussed factors that positively or negatively influence a provider firm's value.

I also failed to find much in the literature or existing studies on the consequences of technology adoption to existing resources—that is, the people, processes, and technology that can create bottlenecks to a seamless implementation of smart technologies. Borrowing terminology from other research, I use the term "*excess baggage"* to refer to these incumbent resources in logistics providers' technology adoption.

IV.7.1 Excess baggage in smart technology adoption

"Excess baggage" was used in prior research as a concept that there is an "initial idea" accepted as a fundamental concept, as in the research in social sciences such as traumatic experiences (Allotey, 2008), devices that add weight to living organisms (Vandenabeele, 2014), and in scientific studies of quantum cosmology (Hartle, 2005) and quantum physics (Hardy, 2003) that provoke the development of future ideas or events (Segrest, 2013).

The term's literal definition is associated with luggage that exceeds an allowable weight limit for each passenger or the amount allowed to be carried on public transportation such as planes or trains that usually requires a fee (*Excess Baggage Definition & Meaning | Dictionary.Com*, n.d.; *Excess Baggage Definition and Meaning | Collins English Dictionary*, n.d.; *Excess-Baggage Noun - Definition, Pictures, Pronunciation And Usage Notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.Com*, n.d.). Other definitions include an unnecessary or unwanted person or thing that becomes burdensome or a traumatic experience, history, or emotional disposition that becomes a debilitating factor in one's life (*Excess Baggage Definition and Meaning | Collins English Dictionary*, n.d.).

In this study, I associate the term with the incumbent people, processes, and technologies from the inception of provider firms that later create challenges; this is in contrast to their newer counterparts, which started business operations with technology at the forefront of their business operations. However, as technology evolves, even these newly established firms will gradually experience the issues that arise in their more established counterparts.

Despite the growing research on Logistics 4.0 and its criticality in addressing challenges that stem from Industry 4.0, the literature on providers and the impact of smart logistics technologies on their businesses is still in its infancy. Despite many theories that have been used to associate their theoretical application of technology adoption and have evolved with technological advancements, these theories are limited relative to the use of technologies in outsourced logistics processes. I compared theories and their evolution—including the Technology-Organization-Environment framework (Baker, 2012), The Theory of Reasoned Action (TRA) (Al-Suqri & Al-Kharusi, 2015; Fishbein, 2008), the Theory of Planned Behavior (Ajzen, 1991, 2020), the Technology Acceptance Model (Davis & Viswanath, 1996; Silva, 2015) and the extended TAM (Fayad & Paper, 2015; Venkatesh & Davis, 2000), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2012, 2016)—to my own research and identified a lack of relationship between these adoption theories and existing factors in a business organization.

As this chapter shows, my findings identified factors that logistics providers consider in smart technology adoption to increase their firm's value despite resource constraints and the existence of incumbent resources, processes, and technologies (excess baggage); these findings are particularly strong for firms that have operated for more than 30 years. My findings presented drivers and consequences that may eliminate challenges for providers. I also identified factors

that moderate smart technology adoption, including business tenure, financial capacity, and length of client relationship relevant to my study; these elements are critical to increasing the awareness of decision-makers, who should examine the impact of these factors in their organizations. Excess baggage typically connotes a negative effect. Examples include the monetary penalty for luggage that exceeds a weight threshold; a slowing down or delaying of movement, as in the flight of birds; or lingering factors that trigger a decision, as in emotional trauma. In contrast, in this study, I discovered that excess baggage might contribute nonfinancial benefits to provider organizations that positively impact firm value. An organization's previous investments in people and processes, and even in old technology, for example, creates the knowledge necessary to deliver value to additional human resources, newer processes, and smart technologies that the firm adopts.

Other factors, however, negatively impact firm value. My research identified pitfalls to smart technology adoption. Identifying these factors is a novel contribution to theory to guide researchers toward smart technology adoption’s continuous evolution and avoid its pitfalls.

IV.8 Managerial Implications

Combining a review of existing literature on this growing topic with my extensive field research findings, I identified drivers critical to logistics providers' smart technology adoption. I synthesized consequences by conducting a thematic analysis of data from interviews with 40 practitioners involved in the decision-making processes of outsourced logistics firms globally. I also found moderators not identified in prior studies and practitioner publications. With the rich data made available through the willingness of my research participants, I developed a framework that guides technology adoption. This framework provides context to my research questions:

What factors should logistics providers consider in smart technology adoption to increase their firm value despite resource constraints (RQ1)?

What are the nonfinancial benefits of smart technology adoption for logistics providers? (RQ2)

Analyzing my research data, I identified drivers and consequences impacting firm value. Providers consider many factors that drive their firm's smart technology adoption. The firms in this study are of different sizes and scales and offer various services. However, all are considered logistics providers and may be classified based on the typology in Chapter 3. These companies' evolution also greatly varies. Some companies are by-products of acquisitions or have evolved independently. Their ownership varies as well. They are either publicly or privately owned and might operate independently, as a parent or child company, subsidiary, division, or part of a global entity. Some of these firms have established their business since the First Industrial Revolution and followed its evolution until the present time. Despite the heterogeneity of respondents, I found a common factor that drives these companies' existence: their customers.

My literature review suggested that internal and external factors drive smart technology adoption. Internal factors include the company's evolution as it correlates with the industry's progress, the objective to retain customer value, the need for process transformation given new market demands and challenges, productivity improvements to retain competitiveness, and financial pressures to retain profitability. In addition, these firms must constantly consider changing market demands and the speed of technological advancements needed to support these demands; the industry's growing and diversifying landscape gives rise to new competition. Supply chain disruptions and the fragmented industry resulting from globalization and its complexities in modern businesses have posed regular challenges for these firms. However, my

findings do not show company evolution, supply chain disruptions, increasing competition, or industry fragmentation as factors driving smart technology adoption. The factors that remain are all directly related to the aim of business growth and business retention. Therefore, my framework suggests that—regardless of organizational size, capabilities, service offerings, financial capacity, or tenure in the business—providers may leverage two key drivers to adopt smart technology: client relationships and market demands. Client relationships safeguard existing businesses and contribute to revenue growth, while market demands generate new business and increase market share from customers serviced by competition.

My findings suggest that business tenure, financial capacity, and length of client relationships moderate smart technology adoption. My findings validate consequences on people and processes, while the determinants of firm value differ. For example, some factors negatively impact firm value, such as the need for change management and teams to manage technology adoption, the constant process adjustments required, and increased operations costs due to errors and delays during implementation of new or enhanced technologies. While my research failed to validate all drivers in the literature as factors the companies consider in practice, no unique drivers emerged from the data.

IV.8.1 Smart Technology Adoption Framework

To avoid pitfalls in smart technology adoption and guide resource allocation, firms must prioritize the most important factors in adopting smart technologies: business retention and growth. Considering the number of available smart logistics technologies and enhancements developed daily, the firms' selection of technology should be driven by existing client relationships and the constant changes in market demands. Figure 11 presents a framework to

guide practitioners through efficient adoption and implementation so that they can realize a positive effect on their firm's value.

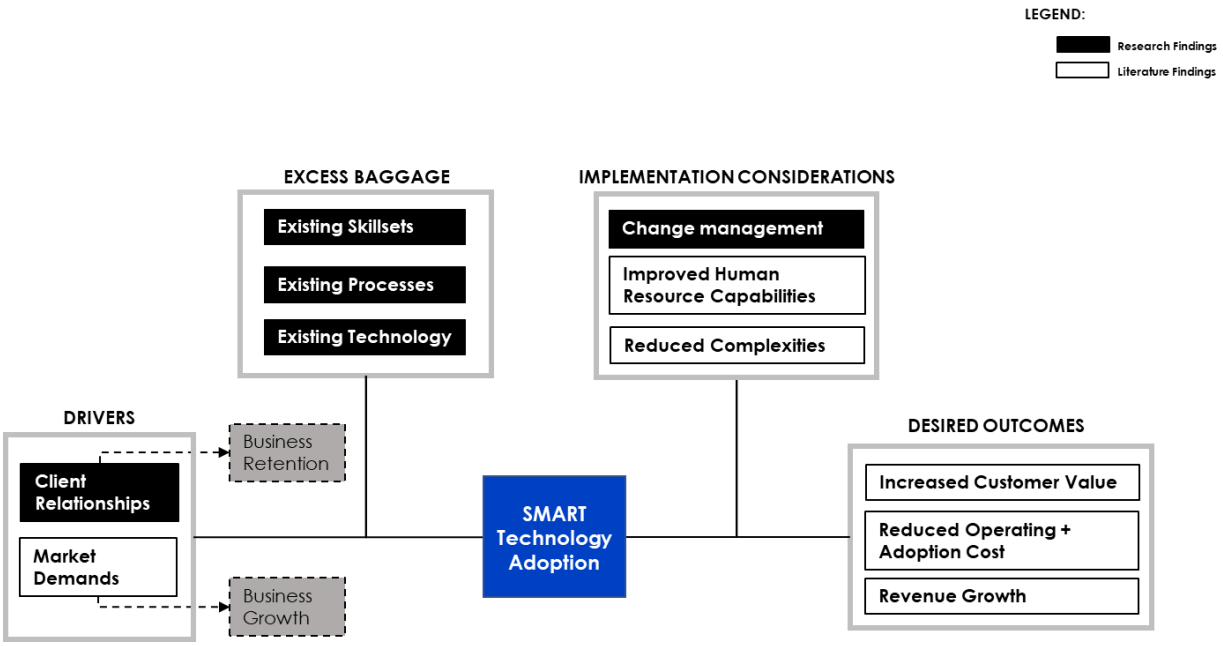

Figure 11 Smart Technology Adoption Framework

IV.8.2 Drivers

Client relationships contribute knowledge and familiarity, enabling providers to retain existing business or facilitate share-of-wallet growth. Firms carry the positive weight of previous experience, which may benefit new customers interested in products and services useful for their supply chain. Furthermore, client relationships allowed providers in my study to enhance processes collaboratively as their relationships evolve. These relationships bred familiarity with businesses in similar industries and enabled the delivery of the same competitive advantage. On the other hand, evolving market demands give providers information to innovate and adjust to new requirements to satisfy new customers. In addition, these adjusted processes may also benefit current customers. Utilizing existing client relationships with evolving market needs will create customer value. Factors that have driven providers' smart technology adoption may not

contribute to their business growth if they fail to create customer value. Customer value and the components customers perceive as valuable may be determined through customer relationships and market demands.

IV.8.3 Leveraging Excess Baggage

The selection of smart technology based on client relationships and market demands may leverage three types of *excess baggage*—existing skillsets, processes, and technology at an organization. (1) Existing employees have a wealth of information about an organization's culture and current processes, as well as knowledge about customer requirements. These existing human resources will be required to learn new technologies and enhance current skill sets to adopt new systems. In conjunction with personnel with new competencies to be added to the organization, combining different sets of people will present dichotomous advantages for different types of customers with varying expectations. (2) Existing processes benefit companies with customers for whom change is slow or who resist adopting changes. Incumbent processes that are working may be streamlined to reduce manual labor through technology use. These old processes may be useful in developing, customizing, and deploying new technologies. (3) Existing technologies may be used in parallel with smart technologies. While enhancements may be necessary, phasing out old technologies must be a gradual process to eliminate possible operational disruptions in the provider's organization. It will thereby appear to be a seamless transition for customers.

These recommendations for capitalizing on a company's excess baggage with changes on the horizon will require a change management process. My research data shows this process may be carried out using various methods. Some companies applied a top-down approach of communicating *what's in it for me* (WIIFM) through firm leaders to other departmental

managers who communicate it to the firm's lower levels. Others used consultants to facilitate the change. One company in my study created a team among various leaders to implement change. Effective change management can reduce adoption costs due to repetitive training, lack of understanding, and acceptance caused by the lack of formalized processes to implement the change. Some change advocates facilitate gathering ideas to improve processes and increase productivity.

IV.8.4 Implementation Considerations

To achieve performance outcomes, firms should consider factors that will improve the implementation of smart technologies in their organizations. While the findings framework did not identify these factors as drivers or consequences of technology adoption, the data gathered from practitioners presented that the change management process is necessary for organizations to consider ensuring proper adoption. Some companies employed services of external parties, such as consultants, while others engaged project management groups within their organization. For some who prefer to manage these within internal groups, the participants shared that they involve leadership from their organization to appoint a leader to adopt technologies.

Change management processes may drive implementation and handle mechanisms to combat organizational resistance. With the combination of old and new – human resources, processes, and technologies- employees will inevitably feel the stress of change, with new colleagues coming into the organization bringing capabilities they do not possess. On top of this, organizations run parallel implementations to avoid disrupting current operations, which requires more working tasks while learning for employees. Providers must intentionally allow resources to improve their skill sets and capabilities for the organization's benefit. Enabling the employees

to learn before deploying new technologies will alleviate mistakes and slow down the change process.

The learning process will allow employees to improve their capabilities, which will help the adoption process. They can act as catalysts for technology adoption and provide additional know-how from their previous experience. When combined with new skills and technologies, providers have the right combination of people, processes, and technologies that positively affect the firm.

Before fully adopting technologies, providers must assess that processes need to be eliminated or adjusted. Like any product, the technology should be tested prior to full implementation. The company needs to adjust processes before the full implementation takes place. Otherwise, firms will more likely incur additional adoption costs and delay the process.

IV.8.5 Desires Outcomes

Every organization has similar desired outcomes to increase value they deliver to customer, reduction of costs – including adoption costs in trhe cas of smart technologies, and revenue growth. Other factors that drive providers' smart technology adoption may result in performance surplus and technologies that do not translate into customer value—thus, customers who are unwilling to pay for them. My framework suggests that customer value should be a consequence rather than a driver. Internal factors requirements from my study data include process transformation, which may result from the company's evolution, market demands, or a specific customer requirement, and financial pressures. As the framework shows, the consequences that will improve firm value will be positive or negative.

Leveraging an organization's excess baggage and combining it with new competencies, processes, and technologies can reduce operating costs by reducing errors and anticipating

mistakes. It may also motivate mutual benefit by encouraging employees with existing skillsets and new competencies to collaborate for productivity enhancement. Combining streamlined and new processes can reduce errors, eliminate redundant, repetitive, or irrelevant processes, and reduce operating costs. Since combining these factors results in increased productivity, companies need to assess whether the value delivered to the customers through the detailed framework results in higher customer value than the operations and adoption costs combined; if so, the result is positive firm value. Otherwise, if the combined operating and adoption costs are higher than the value to customers, adopting smart technologies will negatively impact the firm.

IV.8.6 Blockchain and Generative AI

Logistics practitioners must consider smart technologies such as Blockchain and Generative AI in multiple organizational functions. Blockchain is one of the technologies that play a cardinal role in influencing how other technologies are used for varying purposes. It ensures that all participants within the supply chain network have access to uniform and consistent information to eliminate ambiguity and promote collaboration and transparency (Deloitte United States, 2022). This technology has immense potential to boost efficiency in diverse logistics operations and support process optimization. It also improves data safety among users. With the growth of eCommerce direct-to-customer fulfillment beyond international borders and across continents, the data privacy of consumers can be safeguarded and secure their purchasing experience (Zakharkina et al., 2022)

Generative AI, while in its novelty, will benefit supply chain and logistics functions. In warehousing operations, this technology enables demand forecasting and inventory capacity management, warehouse process optimization and performance management, warehouse layout optimization, error detection, report generation, and, more recently, reverse logistics – analyzing

returns, repairs, and refurbishment data. It also supports data required for last-mile delivery and routing optimization to minimize costs by reducing transit time, fuel consumption, and other associated costs. New technologies powered by Generative AI enable the autogeneration of logistics documentation and compliance for international businesses. For global supply chains, it is beneficial for timely information sharing for collaboration and capacity optimization in air and ocean freight. This smart technology may also support these organizations' administrative, sales and marketing functions.

IV.9 Limitations of the Study

In gathering data for this study, I must report limitations that may cause systematic bias or misperceptions, leading to possible research deficiencies (Price & Murnan, 2004). However, the limitations outlined in the following paragraphs do not affect the generalizability or external validity of the findings.

IV.9.1 General Definitions of Logistics Providers

The evolution of supply chain management due to modernization and globalization further complicated this study of logistics providers. Most research generalizes providers as 3PLs. However, as established in previous chapters, provider firms engage with other organizations as extensions of their supply chains and offer various services supporting upstream and downstream processes. Thus, the term 3PL is frequently misused. Chapter 2 provided a glimpse into the various forms of providers, ranging from 3PL to 5PL, and the different vocabulary used to depend on how these outsourced logistics firms support organizations.

Firms also vary in the types of logistics operations they support. 3PLs primarily offer US domestic operations, including truckload and less-than-truckload pick-up and delivery from a place of origin to an actual destination or multiple pick-ups or destinations for a single customer.

Some 3PLs, whose core service when established was predominantly customs brokerage, added domestic operations to serve the delivery needs of their customers after customs formalities were complete. The emergence of eCommerce created a new industry term. These eCommerce logistics require outsourced providers to manage orders, from goods fulfillment to goods delivery to the ultimate consumer (an individual or a business). The evolution of eCommerce gave rise to Omnichannel distribution which created numerous options for delivery.

For this research, I define full-service as a range of offerings to support multiple segments of upstream or downstream logistics activities. Most provider firms in this study were called “full-service providers” during interviews or in public information. They consider themselves as such because they offer services supporting core products and services, either through other parties or their assets. One limitation of this work is that I use a single, general term to describe these organizations—that is, logistics providers—regardless of their own descriptors or the market’s perception or preference. I differentiate providers in this research only to validate or invalidate factors, such as the company’s evolution, size, service offerings, and others, that may have influenced a firm’s technology adoption decisions. I chose not to delineate each type of provider because the products and services of most of the participating companies overlap. In seeking to determine common factors, the process automatically eliminated exceptions during data condensation. Therefore, in this research, logistics providers are a general term attributed to firms that provide outsourced logistics services to other organizations through integrated processes and technologies and are considered extensions of other firms’ supply chains.

IV.9.2 Field Interview Participants

As the primary researcher, my experience as a long-tenured practitioner became a double-edged sword. The interview participants were selected based on my established business relationships with industry colleagues in the outsourced logistics industry. These relationships developed through healthy competition, as former co-workers in the same company, or through my meetings with other industry colleagues at industry associations and events and sometimes at customer functions. While competition is perceived to be healthy, the research participants may inevitably have withheld information that another company may be able to use to their advantage. Understandably, there may be a certain level of discomfort for participants based on the similarities in their firm's service offerings and those of the logistics provider I am currently employed with. This limitation may also have affected the transparency in information-sharing.

Further, despite the validity and reliability I tried to establish in the research instrument—a questionnaire (Appendix 1) that I distributed to participants in advance, allowing them ample time to prepare—some responses conflicted with publicly available information. In such cases, the disparity may have been due to the timing and updating of public information. Changes may have occurred during the time difference between (1) gathering primary data through the field interview and (2) collecting additional data or validating information shared by interviewees from publicly available information. Or, it may have been due to the lack of an interviewee's access to information based on a hierarchical level or organizational role. The interview participants work at different organizational levels, ranging from C-level executives to directors, and play various roles in different organizational functions. Some are involved only in one division or subsidiary and lack visibility into the organization's overall plans. The heterogeneity in participant selection was intentional, as it contributes richness of data by bringing different perspectives useful for comparison and contrast. I interpreted the data to generalize themes in a

broader perspective rather than concerning a specific function, department, or specific products and services. According to Price and Murnan (Seidel & Berente, 2020), these are the most common threats and limitations in a study that must be reported.

I began gathering data through the field interviews in October 2022, and I expected to complete the process by the end of that year, but this timing posed a challenge. In the industry, the last quarter of the year is typically commonly known in the industry as peak season. While 2022 was considered a "lighter peak," organizations were still cognizant that order volumes were likely to increase during this period. The looming inflation and a possible recession also dampened participants' interest, as they were reducing the workforce in preparation to meet the following year's goals. So, despite the early notification of participants in August of that year, by October, some had gone through organizational or personal changes and opted not to participate in the research. To achieve the desired number of 40, I selected additional participants, which affected the heterogeneity of types of participants and respondents. The upside was that it expanded the study's participants to a global scale. Of the participants selected as replacements, 13 were from other countries, allowing me to test the replicability of the research on a global scale.

IV.9.3 Smart Technologies

This study focuses on the adoption of smart logistics technologies, defined in the previous chapters as the application of technology that facilitates the plethora of innovative and digital elements such as sensors, algorithms, and data involving innovative technology solutions such as big data, AI, and machine learning used in the practical setting (Akhilesh, 2020). Studies emerged on smart logistics technologies and their effectiveness in actual operations, including research on autonomous warehouses for trans-shipment, cross-docking, and transportation

(Gromovs & Lammi, 2017); autonomous guided vehicles, such as trucks, cars, cranes, robots, drones, and rails (X. Liu et al., 2010; Q. Wang et al., 2010); EDI (Sheffi, 1990); real-time information for visibility (Akkaya & Kaya, 2019; G.-S. Cho, 2018; de Vass et al., 2018; Premkumar et al., 2021); remote operations monitoring (Markov & Vitliemov, 2020); routing and optimization, (Hunaid et al., 2020); smart infrastructure, such as logistics parks, distribution centers, and warehouses (Gill et al., 2022; Kumar et al., 2020; Lin, 2008; Mostafa & Hamdy, 2018; Pandian, 2019; Vinogradova et al., 2021); transportation management and warehouse management systems (Aravindaraj & Rajan Chinna, 2022; Atwani et al., 2022; Chung, 2021; Kim et al., 2008); blockchain technology for eCommerce transactions (Nadeem et al., 2019; Raja Santhi & Muthuswamy, n.d.; Zakharkina et al., 2022); AI for order fulfillment (Fulconis & Paché, 2018; Gill et al., 2022); real-time tracking (Frazzon et al., 2019; Kawa, 2012; Paul, et al., 2019); reductions in delivery time (Di Maria et al., 2022; Frazzon et al., 2019; Nasiri et al., 2020; Rodrigue, 2020); and robotics and automation to augment human resources and to manage repetitive processes and administrative functions (Bhatti et al., 2020; Ralston & Blackhurst, 2020; Syed et al., 2020).

Unlike these studies that focused on specific technologies, my research is focused on how adopting such technologies impacts the value of logistics providers' firms considering the cost of technology, the required implementation and adoption resources, and the time element. The total return on investment for adopting these technologies is harder to quantify. Furthermore, the industry's competitive landscape creates a price war in which the costs of enhancements are not covered by contractual agreements, despite their benefits to the organization. Although the data I gathered through field research touched on specific smart technologies that the providers had implemented, my study focuses on the effect of such innovations on their firms.

IV.9.4 Impact on Customer Value

The original intent of this research was to assess the impact of customer value in relation to smart technology adoption by logistics providers. In contrast to the literature findings, which identify customer value as a driver of technology adoption, my findings show it as a consequence of technology adoption. A limitation of this study is that I was unable to include the perspective of customers to triangulate findings gathered from providers. While I am currently employed with a global company with thousands of customers all over the world, using such resources would prove lopsided. It will not present the perspectives of other similar organizations. The option to present strong internal validity might exist, but doing so would not present a strong external validity, given that responses would be biased toward a single organization.

IV.10 Recommendations for Future Research

IV.10.1 Services and Geography

Because this study generalized logistics providers in a broader context, future research may aim to narrow the focus to providers classified as the same type of service offerings. For example, they might focus on the smart technologies' adoption of 3PLs with full-service offerings. Future work might also be based on service offerings or geographical coverage. As an example, future researchers can study the impact of smart technology adoption in outsourced warehousing and distribution in the United States.

IV.10.2 Industry Disruptors

Further research may also compare incumbents and disruptors for a specific outsourced logistics service, such as smart technology adoption of eCommerce logistics providers. Given the increased interest in academia about logistic providers' use of smart technologies, this study could be expanded upon in numerous other ways as well.

IV.10.3 Upstream and Downstream Processes

While some studies focus on specific technologies, overlap exists between the value that specific technologies deliver to providers' customers triangulated with the providers' own use of such systems and tools. This perspective offers another opportunity for further research. Technologies continue to evolve, and their utilization in the supply chain processes is vast; the missing link is the association of technologies to the upstream and downstream processes that providers deliver.

IV.10.4 Logistics 5.0

Also, despite numerous studies on Industry 4.0, research gaps remain regarding Logistics 4.0. Digital innovation in logistics continuously evolves. The newest trend experts have identified is Logistics 5.0, a novel concept introduced in Japan in 2019. The newness of the concept limits its coverage in literature. With the recent industrial revolution's focus on sustainability and social governance, there has been an escalation in smart technologies development as a result. As the market expands, the speed of evolution and progress of logistics will require more studies on providers' technology adoption and their customers. Due to its novelty in academia, there is an opportunity to expand smart technology research in Logistics 5.0.

IV.10.5 The Future of Work

While my research presented the misconception of having the existing workforce as "*excess baggage"* as a negative connotation due to the training and education required to improve their skillsets, the baggage they bring includes technical industry knowledge, critical thinking skills, and approaches learned through experience. It is inevitable for providers to capture and leverage this baggage to adopt best practices and adjustments of current processes to

avert potential risks. Studies around human resources from different generations and the future of work, leveraging technologies, impact logistics provider firms.

Logistics 5.0 expanded the concept developed during the 4th industrial revolution that technology will rule the world. Its paradigm involves the combination of human and technological resources in cyber-physical systems. Future researchers may study the impact of the previous generation of workers –their technical and critical thinking abilities acquired through experience and adoption of smart technologies – and their benefit to customers' supply chains.

V CHAPTER 5 CONCLUSION

To address the real-world dilemma described in my research questions, I evaluated factors logistics providers must consider in adopting smart technologies to increase their firm's value despite resource constraints. Themes emerged from the data I gathered from field research with 40 executives from global logistics provider firms. These themes include both the drivers and consequences to consider when adopting technologies. Borrowing from other literature fields, I used the term *excess baggage* to refer to the non-financial benefits firms receive through existing human resources, processes, and technologies. Although excess baggage typically connotes a negative effect, firms often miss possible non-financial benefits that impact their organizations, such as the knowledge of customer requirements, the organizational culture, and incumbent processes that may be used as learning tools in gradually adopting technologies. Although prior studies have characterized excess baggage as slowing down a process due to extra literal or figurative weight or as something that creates adversity or limits an incident or idea's evolution, in this research, excess baggage can facilitate gradual implementation and change management that actually improves efficiency.

In turn, these efficiencies support existing and new processes. Implementing a proper combination of both can lead firms to deliver positive results and alleviate potential pitfalls. As exemplified in anecdotal evidence from cases such as DHL's NFE environment (*DP-DHL Finally Abandons Ill-Fated NFE IT Project and Is Forced to Write off €345m - The Loadstar*, n.d.; *Getting I.T. Right: What Forwarders Can Learn from DHL's Struggle | Air Cargo World*, n.d.; *SAP: Don't Blame Us for DHL's Logistics Woes | Computerworld*, n.d.) and Maersk's experiences with the TradeLens blockchain technology (Maersk, 2022; Trueman, 2022), many providers and intermediaries have attempted full-blown, multi-year implementations with massive investments. These companies, however, failed to consider the learnings from their

legacy and the implications of such an effort on their incumbent processes and existing human resources.

Each of the 40 research participants concluded the interviews by describing their organization's technology plans. Of these companies, 19 planned to add functionalities or enhancements to their existing platforms and tools; 8 intended to invest in new systems; and only one planned to undergo a complete system change in the near future. The remaining 12 participants opted not to divulge their company's plans. Still, as the ratio shows, most of the companies are allowing technologies to evolve, despite the investment and resource constraints, which shows how essential technology adoption is to their organizations.

As I noted at the start of this discussion, the world is getting smaller. It will continue to do so as ever-new technologies develop and enable producers and consumers to explore better new markets, ideas, products, and services. Throughout this evolution, supply chain processes will require more and more complex logistics operations, and the outsourcing of these activities will continue to evolve with technology. Given this, logistics providers must be more intentional in prioritizing their investments. While adoption of new technologies are necessary, providers must be more aware of the non-financial benefits of existing elements in their firms, which they may currently perceive as simply *excess baggage*.

APPENDICES

Appendix A: Glossary of Terms

Service	Definition	Reference (Article or Book)
Freight Forwarding	involves organizing and transporting goods from one location to another using various carriers such as air, sea, rail, or road. The main goal of freight forwarding is tBuo efficiently and affordably move goods while ensuring they remain in good condition throughout the journey.	Farrow. (2022, March 21). *What is Freight Forwarding	Farrow*. https://farrow.com/resources/what-is-freight-forwarding/
Freight brokerage	or transportation brokerage, acts as a middleman between the shipper, who requires transportation for their cargo, and the carrier (typically a trucking company) that can provide the necessary services. By utilizing a network of regional, national, and international trucking companies, a freight broker can match the shipper's needs with the available truck and trailer capacity to transport their freight to its intended destination	*What is Freight Brokerage? Logistics Terms and Definitions	Saloodo!* (n.d.-b). Saloodo! https://www.saloodo.com/logistics-dictionary/freight-brokerage/
LTL	less than track load, transporting goods or products that don't require a full truckload. Numerous smaller shipments are combined and transported on a single truck. LTL shipments are commonly arranged on pallets and can weigh anywhere between 150 pounds to 10,000 pounds.	C.H. Robinson. (n.d.). *How LTL Freight Shipping Works	C.H. Robinson*. https://www.chrobinson.com/en-us/resources/blog/what-is-ltl-freight-how-can-it-work-for-you/#:~:text=Less%20than%20truckload%20(LTL)%20freight,being%20transported%20on%20one%20truck.
Transportation Management	a component of logistics that encompasses various processes within the supply chain, ranging from supplier selection to invoice processing. Logistics companies aim to optimize these processes in terms of cost-effectiveness. The implementation of a Transportation Management System (TMS) aids in enhancing operations, driving business growth, and delivering improved service to customers. TMS offers several benefits, including reduced freight expenses, enhanced customer service, improved goods receipt efficiency,	Reid, H. (2022, January 25). 5 Benefits of a Transportation Management System. *DCL Logistics*. https://dclcorp.com/blog/fulfillment/transportation-management/

	optimized supply chain operations, and better warehouse management.	
Warehousing	plays a crucial role in the retail supply chain by storing physical goods or inventory in a designated facility until they are ready to be sold or distributed. The primary purpose of warehouses is to ensure the safe and secure storage of products in an organized manner, enabling easy tracking of item location, arrival dates, duration of storage, and available quantities.	Team, A. C. (n.d.). *What is warehousing? A guide to logistics*. https://business.adobe.com/blog/basics/what-warehousing-guide-logistics#:~:text=Warehousing%20is%20the%20process%20of,or%20individually%20to%20end%20consumers.
Warehousing (and distribution)	encompass a range of activities such as packaging, storage, transportation, stock control, and inventory management services. Its purpose is to minimize the expenses associated with delivering finished products to customers while simultaneously maintaining or enhancing the level of service provided.	*Warehousing and Distribution Logistics Market Solution, Size*. (n.d.). Allied Market Research. https://www.alliedmarketresearch.com/warehousing-and-distribution-logistics-market-A11526#:~:text=Warehousing%20and%20distribution%20logistics%20deals,the%20level%20of%20service%20provided.
Customs brokerage	plays an important role in facilitating the transportation and delivery of goods across international borders for individuals and organizations. Their primary responsibility is to have extensive knowledge of customs regulations and ensure compliance to streamline the shipping process for their clients.	Farrow. (2022a, March 21). *What is Customs Brokerage	Farrow*. https://farrow.com/resources/what-is-customs-brokerage/
Control tower (Supply chain control tower)	seeks to improve the transparency and collaboration among trade partners, such as businesses, countries, and transportation modes. It serves as a central repository for collecting and organizing data, which is then shared with stakeholders in a standardized format. By capturing real-time analytics, a control tower enables logistics providers to enhance their operations, adapt to evolving consumer needs, and ultimately enhance visibility throughout the entire supply chain.	Curoe, M. (2021). What is a Control Tower and how does it Work? *Redwood Logistics*. https://www.redwoodlogistics.com/what-is-a-control-tower/
Last mile delivery	refers to the final stage of delivering a customer's order, where the goods are transported from a distribution center or store to the ultimate destination—the end customer. This crucial step is typically carried out by parcel carriers, couriers, less-	Pillar, R. (n.d.). *What is Last Mile Delivery?	Descartes*. https://www.descartes.com/resources/knowledge-center/what-is-last-mile-delivery-and-why-is-it-important

	than-truckload (LTL) carriers, or dedicated fleets.	
Omni-channel	is primarily focused on ensuring customer satisfaction by offering a seamless flow of processes and a single point of contact. It provides customers with various options, including: (1) the ability to order online and pick up the product from a designated store location, (2) the convenience of ordering online and having the product delivered to their preferred address, and (3) the option to purchase a product from a physical store and have it delivered to their preferred address. This flexibility in omnichannel logistics aims to cater to diverse customer preferences and enhance their overall experience.	Menon, H. (2022). What is Omnichannel Distribution in Logistics? *Marine Insight*. https://www.marineinsight.com/maritime-law/what-is-omnichannel-distribution-in-logistics/
White glove delivery	a specialized service that goes beyond the standard pick-up and drop-off process commonly associated with deliveries. It applies to situations where a product requires installation or placement inside a customer's home. With white glove delivery, utmost care is taken during transit to ensure the safe handling of the items.	Gayst, M. (2023). What Does White Glove Delivery Mean? *Locate2u*. https://www.locate2u.com/articles/what-does-white-glove-delivery-mean/
Direct to consumer parcel delivery	adopted by brands that choose to sell their products directly to consumers without involving intermediaries like distributors, retailers, wholesalers, or other channels. D2C offers various fulfillment options, such as in-house fulfillment where companies sell their items through platforms like Amazon or other marketplaces.	*What is Direct-to-Consumer Delivery?	What is D2C Delivery?* (n.d.). Locus. https://locus.sh/resources/glossary/direct-to-consumer-delivery/
Contract logistics	refers to the complete process that encompasses production, distribution, and reaching the final point of sale. It goes beyond the mere transportation of goods and involves integrating traditional logistics with supply chain management activities. In this context, the concept of a 4PL (Fourth Party Logistics) comes into play.	TIBA. (2017, January 24). *What is Contract Logistics?* https://www.tibagroup.com/mx/en/contract-logistics-process#:~:text=Contract%20Logistics%20is%20defined%20as,with%20supply%20chain%20management%20processes.
Same-day delivery	ensures that purchases are delivered within a few hours of being made or within a specified time frame on the same day. It is a transformative concept as it	*Same-day delivery: The next evolutionary step in parcel logistics*. (2014, March 1). McKinsey & Company. https://www.mckinsey.com/industrie

	combines the advantages of immediate product availability typically found in physical retail stores with the convenience of online ordering from the comfort of one's home.	s/travel-logistics-and-infrastructure/our-insights/same-day-delivery-the-next-evolutionary-step-in-parcel-logistics
Time-critical logistics	specifically tailored to handle shipments that require precise delivery on a predetermined day and time, as well as freight that needs to reach its destination with utmost speed. Time-critical logistics are dedicated to ensuring the timely arrival of shipments on a specified day and time, and to expediting the transportation of freight to its final destination.	Ltd, P. P. a. F. I. P. (n.d.). Time Critical Logistics. *www.linkedin.com*. https://www.linkedin.com/pulse/time-critical-logistics-pafex-1f/
Global Supply Chain Management	encompasses the strategic planning and coordination of the entire supply chain as a unified entity, with the goal of achieving optimal customer service levels while maximizing cost efficiency. It involves implementing management processes that seamlessly integrate the network of suppliers, manufacturers, warehouses, and retail outlets. The aim is to ensure smooth collaboration and coordination across all elements of the supply chain to enhance customer satisfaction and drive operational effectiveness.	Team, F. (2022, December 5). *What is global supply chain management? - Trade Ready*. Trade Ready. https://www.tradeready.ca/2017/topics/supply-chain-management/global-supply-chain-management/
Supply chain management	involves overseeing the complete process of producing a product or providing a service, beginning from the procurement of raw materials and extending to the delivery of the finished product to the end consumer. It encompasses the management and coordination of various activities, including sourcing, production, transportation, storage, and distribution, to ensure the smooth flow of goods or services throughout the entire supply chain.	*What is supply chain management?	IBM*. (n.d.). https://www.ibm.com/topics/supply-chain-management
3PL	a service that involves the handling of stock shipments, inventory storage, tracking, and the fulfillment process for customer orders. This includes tasks such as picking and packing items for shipment to end customers.	Rheude, J., & Rheude, J. (2023). What Is a 3PL? Third-Party Logistics Definition, Process, and Resources. *Red Stag Fulfillment*. https://redstagfulfillment.com/3pl-definition-process-resources/
4PL	an operational framework where a company delegates its complete	What is Fourth Party Logistics? (2020). *Supply Chain Magazine*.

	supply chain management and logistics functions to an external service provider. It takes charge of coordinating and overseeing all logistical operations on behalf of the customer.	https://supplychaindigital.com/digital-supply-chain/what-fourth-party-logistics
Risk management (Supply chain risk management)	a methodical approach to effectively handle and mitigate potential risks within a supply chain. It involves systematically identifying weaknesses, vulnerabilities, and threats that may exist at various stages of the supply chain, including suppliers, products, and subcomponents.	CSRC Content Editor. (n.d.). *supply chain risk management (SCRM) - Glossary	CSRC*. https://csrc.nist.gov/glossary/term/supply_chain_risk_management
Trade Compliance	encompasses the regulations and requirements governing trade activities between two or more countries, encompassing aspects such as training, lending, classification, risk assessment, and the payment of duties or taxes.	Welch, P. (2023). What Is Trade Compliance? *Flash Global	40 Years*. https://flashglobal.com/what-is-trade-compliance/#:~:text=Trade%20compliance%20describes%20the%20terms,country%20it%20does%20business%20with.
E-commerce	referred to as electronic commerce or internet commerce, involves the online buying and selling of goods or services. This process entails the exchange of money and data over the internet to facilitate the completion of sales transactions.	Zande, J. V. (2023, March 15). What is e-commerce in 2023? Definition, benefits, examples. *The Future of Commerce*. https://www.the-future-of-commerce.com/2020/01/19/what-is-e-commerce-definition-examples/
(International) Logistics Provider	an entity that provides a wide range of logistics and supply chain management services to businesses such as transportation, warehousing, inventory management, order fulfillment, customs brokerage, and related activities	*What Is a Logistics Service Provider (LSP)?* (2023, June 2). Penske Logistics. https://www.penskelogistics.com/insights/logistics-glossary/what-is-a-logistics-service-provider#:~:text=A%20logistics%20service%20provider%20(LSP)%20is%20an%20outsourced%20company%20that,transportation%2C%20warehousing%20or%20distribution%20services.
NVOCC (Non-Vessel Operating Common Carrier)	a maritime transportation company that provides carrier services without owning its own vessels. It operates by leasing or purchasing available space in containers and uses its own House Bill of Lading to enter into contracts with customers. It acts as a middleman between shippers and ocean carriers,	*Non-Vessel Operating Common Carrier (NVOCC) Definition	UPS Supply Chain Solutions - United States*. (n.d.). https://www.ups.com/us/en/supplychain/insights/knowledge/glossary-term/nvocc.page#:~:text=What%20is%20a%20Non%2DVessel,Lading

	facilitating the transportation of goods by utilizing container space on various vessels.	%20to%20contract%20with%20customers.
Dedicated transportation	a customized transportation service that exclusively utilizes vehicles or resources for a specific customer or company. In this arrangement, a logistics provider or carrier allocates dedicated assets, such as trucks or drivers, solely to fulfill the transportation requirements of a particular customer or business.	*Dedicated Trucking: Definition, Benefits, & Challenges – Freight Course*. (n.d.). https://www.freightcourse.com/dedicated-trucking/
Cross-docking	a logistics process in which products sourced from a supplier or manufacturing plant are directly delivered to a customer or retail chain without significant handling or storage time. This operation typically occurs at a distribution docking terminal equipped with trucks and dock doors on both inbound and outbound sides, with minimal storage capacity.	*What is Cross-docking - Understanding the concept & definition*. (2011, December 23). Adaptalift. https://www.adaptalift.com.au/blog/2011-12-23-what-is-cross-docking-understanding-the-concept-definition
Drayage	type of trucking service that facilitates the connection between various shipping modes, such as ocean freight or air freight, in the transportation of goods. This service involves a short-distance trip that moves the goods from one location to another, typically before or after their long-distance shipping journey.	iContainers, & iContainers. (2022, January 12). What is drayage? Meaning & Classification | iContainers. *iContainers*. https://www.icontainers.com/help/what-is-drayage/
Intermodal (transportation)	the transportation of oversized goods using standardized containers that are transported across multiple modes of transport, such as trucks, trains, and ships. This method eliminates the need to unload and reload the goods between different vehicles, as the containers themselves are transferred from one mode of transport to another.	Adanza, F. (2023, May 13). *What Is Intermodal Transportation? Definition and Motivations - With Vector*. With Vector. https://www.withvector.com/what-is-intermodal-transportation-definition-and-motivations/
Value-added service	additional services provided in conjunction with logistics operations to enhance the overall value and functionality of the service. These services go beyond the basic transportation and storage of goods. Examples of value-added services include activities such as order picking, packaging, labeling, managing returns, and providing shelf services.	*Value Added Services in logistics | BLG LOGISTICS*. (2021, June 30). BLG Logistik. https://www.blg-logistics.com/en/magazine/our-value-added-services-create-extra-value

Order-fulfillment	the essential process of gathering and shipping customer orders, along with the accompanying activities that facilitate these tasks. It occurs in one or multiple distribution centers and encompasses various functions such as inventory management, supply chain management, order processing, quality control, and customer support for handling issues, exchanges, or returns related to products.	Schwarz, L. (2022). What Is Order Fulfillment? 7 Step Process & Key Strategies. *Oracle NetSuite*. https://www.netsuite.com/portal/resource/articles/erp/order-fulfillment.shtml
Shipping	refers to the tangible transportation of goods from one location to another, which can involve moving products from a warehouse or storage facility to the customer's designated destination. This phase of the supply chain occurs after the manufacturing and packaging of goods and is typically managed by a shipping or logistics company.	*Logistics terms	What is shipping?* (n.d.). Twill. https://www.twill.net/faq/logistic-terms-updates/what-is-shipping/
Unattended delivery	type of delivery service where packages or goods are left at a predetermined location without the recipient needing to be present or sign for the delivery. The recipient can provide instructions on where to leave the package, such as a doorstep or a secure spot. Unattended delivery offers convenience and efficiency, especially when the recipient is unavailable during the delivery time.	Ross, C. (2022). Unattended Delivery --An Agile Alternative -- Article by Gary A. Smith --Supply Chain Mavens — Supply Chain Mavens. *Supply Chain Mavens*. https://www.supplychainmavens.net/fwiw/2022/10/27/unattended-delivery-an-agile-alternative
Freight shipping	involves the movement of commodities, goods, and cargo using various modes of transportation such as land, sea, or air. It encompasses the transportation of large quantities of goods, and common methods of freight shipping on land include full truckload, less than truckload (LTL), and intermodal transportation.	*What Is Freight Shipping?	Freightquote*. (n.d.). https://www.freightquote.com/define/what-is-freight-shipping/#:~:text=Freight%20shipping%20is%20the%20process,%2C%20train%2C%20ship%20or%20plane.
Supply chain optimization	involves employing various techniques and strategies to enhance the performance and efficiency of manufacturing and distribution supply chains, considering all relevant limitations. Technologies for optimizing the supply chain network utilize advanced algorithms and analytics to achieve a balance between supply and demand.	*What is Supply Chain Optimization? Definition and FAQs	HEAVY.AI*. (n.d.). https://www.heavy.ai/technical-glossary/supply-chain-optimization

Express delivery/distribution	high-speed shipping option that offers the quickest transportation of goods. Customers are required to pay an additional fee for this expedited service, which ensures that their shipment will be delivered to them within a relatively short time frame, typically ranging from 24 to 72 hours.	*What is Express Delivery? Logistics Terms and Definitions	Saloodo!* (n.d.). Saloodo! https://www.saloodo.com/logistics-dictionary/express-delivery/#:~:text=Express%20delivery%20is%20the%20fastest,for%20the%20future%20of%20logistics%3F
Road transport	refers to the movement of goods and individuals from one location to another using roadways. A road serves as a pathway connecting two destinations, and it is constructed or improved to facilitate the transportation of both motorized and non-motorized vehicles.	*What is ? Definition of , Meaning - The Economic Times*. (n.d.). The Economic Times. https://economictimes.indiatimes.com/definition/road-transport%60
Land transport	refers to the movement of goods, materials, and personnel using various modes of transportation that operate on land, such as trucks, vans, trains, and pipelines. It involves the transportation of goods within a country or across borders, covering both short-distance and long-distance journeys.	Admin. (2020, June 23). *What is land transport and what is its role in the logistics chain? - JAH Insurance*. JAH Insurance. https://www.jahinsurance.com/en/que-es-el-transporte-terrestre-y-cual-es-su-rol-en-la-cadena-logistica/
Rail freight	method of transporting goods utilizing freight trains, and it is one of the predominant means of transporting goods over land, alongside road freight. It involves the movement of goods via rail networks, offering an efficient and reliable transportation option.	Möller, P. (2023). Rail Freight 101: Sustainable Overland Transport. *DHL Freight Connections*. https://dhl-freight-connections.com/en/business/rail-freight-101-sustainable-overland-transport/
LCL	Less than Container Load, a versatile and economical choice for transporting smaller shipments that do not fill an entire shipping container, typically between major ports worldwide. This adaptable shipping solution is suitable for a wide range of shipment sizes, from small parcels to larger consignments.	*FCL vs. LCL - What is the meaning of these shipping terms? - SHIPSTA*. (n.d.). https://blog.shipsta.com/en/blog/fcl-lcl-shipping
FCL	Full Container Load, refers to a shipping arrangement where a single shipper owns and utilizes the entire space of a container without sharing it with other shippers. In this scenario, the entire contents of the container belong to one shipper, ensuring exclusive use of the container for their goods.	*FCL vs. LCL - What is the meaning of these shipping terms? - SHIPSTA*. (n.d.). https://blog.shipsta.com/en/blog/fcl-lcl-shipping

Ocean freight	vital mode of transportation for moving large quantities of goods across international borders. It involves the shipment of goods through sea routes, enabling the efficient and cost-effective movement of merchandise between countries.	Alibaba.com. (2021). What is ocean freight: a complete guide. *Alibaba.com Seller Central*. https://seller.alibaba.com/businessblogs/px6pr5bh-what-is-ocean-freight-a-complete-guide
Air freight	refers to the transportation and delivery of goods using an air carrier, whether it's a commercial airline or a chartered flight. This method involves shipping items from commercial and passenger aviation hubs to any destination accessible by air transportation.	Farrow. (2022a, March 21). *What is Air Freight	Farrow*. https://farrow.com/resources/what-is-air-freight/
Inland Trucking/Transportation	encompasses the overall logistics activities associated with the movement of goods from a port to an inland facility, as well as the transportation of goods between various locations, and the return of goods from an inland facility to a shipping port.	Transportify Media. (2021, February 7). Inland Transportation Operations Of A Cargo Trucking Company. *https://www.transportify.com.ph*. https://www.transportify.com.ph/inland-transportation-cargo-trucking-company/
Supply chain logistics	involves the management and coordination of the storage and transportation of goods and services throughout the supply chain. This process starts with the acquisition of raw materials, proceeds with manufacturing and/or distribution, and concludes with the delivery of finished products to customers or the return of items to their designated location.	NetSuite.com. (2023, April 4). *Supply Chain vs Logistics: What's the Difference?* Oracle NetSuite. https://www.netsuite.com/portal/resource/articles/erp/supply-chain-management-vs-logistics.shtml#:~:text=Supply%20chain%20logistics%20coordinate%20the,returned%20to%20their%20final%20destination.
Product sourcing	refers to the process of identifying and procuring the specific products that you intend to sell in your store. This involves locating suitable suppliers, purchasing the desired goods from them, and subsequently reselling those products to your customers.	Olson, M. (2022, August 22). *Product Sourcing Guide: Where and How To Source Products*. ShipBob. https://www.shipbob.com/blog/product-sourcing/
Lead logistics	refers to the comprehensive oversight and control of an entire supply chain. It encompasses the activities and strategies involved in managing the complete lifecycle of a supply chain, starting from the sourcing of raw materials to the final delivery of products to end customers, including all intermediate stages and processes.	Hand, R. (2022, September 19). *Guide to Lead Logistics Providers (LLPs): Pros & Cons*. ShipBob. https://www.shipbob.com/blog/lead-logistics/#:~:text=That%20said%2C%20lead%20logistics%20is,and%20every%20step%20in%2Dbetween.

Business services	encompass a range of tasks and activities that contribute to the functioning and success of a business, even though they do not involve the direct production or delivery of physical goods. One such example is information technology, which supports various other business functions such as procurement, finance, and logistics.	Vedantu. (n.d.). Business Services. *VEDANTU*. https://www.vedantu.com/commerce/business-services
Consolidation	involves the combination of multiple shipments within a specific region into a single load, which is then transported by a carrier to another region. The load is subsequently divided into smaller parts and delivered to various destinations within the region by a regional carrier, or vice versa.	Griffith, C. (2023). What is Freight Consolidation? *Trinity Logistics, a Burris Logistics Company*. https://trinitylogistics.com/what-is-freight-consolidation/
Integrated supply chain management	involves adopting an enterprise resource planning (ERP) strategy for effectively managing the supply chain. Instead of employing multiple systems within the organization, this approach allows businesses to establish and maintain relationships with all suppliers while overseeing distribution and logistics activities through a centralized system.	*White paper on Integrated Supply Chain Management A Strategic Perspective - Wipro*. (n.d.). https://www.wipro.com/consulting/white-paper-on-integrated-supply-chain-management-a-strategic-perspective/
Supply chain consulting	entails the provision of advisory services aimed at optimizing inventory and administrative processes. These services encompass a range of guidance, including production planning, estimating demand, planning procurement, controlling inventory management, and designing warehouses.	Admin. (2022). Understanding Supply Chain Management Consulting. *TVS Supply Chain Solutions*. https://www.tvsscs.com/understanding-supply-chain-management-consulting/#:~:text=Supply%20chain%20consulting%20refers%20to,management%20control%20and%20warehouse%20design.
Logistics insurance	provides protection for all parties engaged in transportation, storage, or coordination of related activities. This coverage extends to various entities such as trucking companies, freight forwarders, warehouse operators, non-vessel owning common carriers (NVOCC), customs brokers, and freight brokers.	*Cargo and Logistics	Insurance Broking & Risk Management	Marsh*. (n.d.). https://www.marsh.com/lt/en/industries/cargo.html#:~:text=Logistics%20insurance%20products%20offer%20protection,customs%20brokers%2C%20and%20freight%20brokers.
Multimodal transportation	pertains to the logistics and freight procedures that involve the utilization of multiple transportation modes. This approach enables the cargo to be handled in various	Miashkova, Y. (2022, December 12). Multimodal Transportation: Definition, Challenges, and Solutions. *track-pod.com*. https://www.track-

	ways, depending on the carrier responsible for each leg of the journey.	pod.com/blog/multimodal-transportation/
Destination management	involves the organized administration of all the components that constitute a tourism destination. It adopts a strategic approach to connect and enhance these often distinct elements, aiming for improved overall management of the destination.	Reali, C. (2022). What is Destination Management and Why is it Important. *Mize*. https://www.hotelmize.com/blog/what-is-destination-management-and-why-is-it-important/
Location optimization	Logistics optimization, strategic approach adopted by companies to address the increasing need for rapid and efficient supply chain operations. This approach centers around various aspects of the supply chain and identifies opportunities for improvement at different stages. Its primary goal is to minimize costs throughout the entire supply chain, reduce lead times, and improve overall customer satisfaction.	*Logistics Optimization: Importance, Process, and Optimization - Inbound Logistics*. (2023, February 23). Inbound Logistics. https://www.inboundlogistics.com/articles/logistics-optimization/
On-demand delivery	refers to a customer-centric option where individuals have the freedom to not only choose their preferred delivery location but also specify the desired timeframe, aiming for the quickest possible delivery. Additionally, customers have the ability to track their shipments in real-time and make arrangements accordingly in their schedules.	*What is On-Demand Delivery & How It Works	DHL Express PH*. (2022, May 13). https://www.dhl.com/discover/en-ph/e-commerce-advice/e-commerce-best-practice/Why-Should-You-Introduce-On-Demand-Delivery-For-Your-E-Commerce-Business#:~:text=In%20the%20e%2Dcommerce%20world,and%20plan%20their%20schedules%20accordingly.
Inventory management	an essential component of the supply chain, involving the systematic monitoring of inventory as it moves from manufacturers to warehouses and ultimately to the point of sale. The primary objective of inventory management is to ensure the presence of the correct products in the appropriate location precisely when they are needed.	*What is inventory management and how does it work?	IBM*. (n.d.). https://www.ibm.com/topics/inventory-management#:~:text=Inventory%20management%2C%20a%20critical%20element,place%20at%20the%20right%20time.
Transloading	refers to the act of transferring a shipment from one transportation mode to another, such as transitioning from an ocean container to a truck or rail. This practice is often employed when shipments need to be distributed across multiple warehouse locations and necessitate the consolidation of cargo onto pallets.	Howard. (2022). What is Transloading? *BOA Logistics*. https://www.boalogistics.com/drayage/what-is-transloading/

Reefer containers	a specialized type of container designed to transport perishable items, including medicines, food, and vaccines, which require specific temperature control. Resembling a large refrigerator, this container is capable of maintaining regulated cold temperatures, typically ranging from -30°C to +30°C.	Kuehne+Nagel. (n.d.). *What is a reefer container? Facts & dimensions*. Kuehne + Nagel. https://home.kuehne-nagel.com/-/knowledge/what-is-a-reefer-container
Break bulk terminals	port facilities specifically designed to streamline the process of consolidating or separating individual or bundled cargo, thereby facilitating the overall shipping of break bulk goods. These terminals handle a variety of bulk cargo, including grains, scrap materials, sugar, vehicles, beans, pipes, and similar items, which are transported to the terminals via trucks or trains.	*A Guide to Break Bulk Terminals – Freight Course*. (n.d.). https://www.freightcourse.com/break-bulk-terminals/#:~:text=Break%20bulk%20terminals%20are%20port,terminals%20via%20trucks%20or%20trains.
Supplier management	refers to a well-organized initiative aimed at overseeing and enhancing the influence of suppliers on the buyer's business. This program encompasses various aspects, including monitoring vendor deliverables, fostering collaborative partnerships to jointly develop innovative processes, ensuring compliance, and effectively handling invoice payments.	*What is Supplier Management?* | *GEP*. (n.d.). GEP. https://www.gep.com/knowledge-bank/glossary/what-is-supplier-management#:~:text=Supplier%20management%20is%20a%20structured,well%20as%20payment%20of%20invoices.
MTS	a manufacturing approach that relies on forecasted product demand to determine production planning and scheduling. Under this strategy, goods manufactured during a specific production period are intended to meet the orders received in the subsequent production period.	*What is make-to-stock (MTS)* | *Siemens Software*. (n.d.). Siemens Digital Industries Software. https://www.plm.automation.siemens.com/global/en/our-story/glossary/what-is-make-to-stock-mts/100404
Transportation brokerage	a distinct business sector that focuses on coordinating and forwarding freight orders to appropriate freight carriers. It should be distinguished from freight forwarding, as freight brokerage does not possess its own vehicles or storage facilities.	*What is Freight Brokerage? Logistics Terms and Definitions* | *Saloodo!* (n.d.). Saloodo! https://www.saloodo.com/logistics-dictionary/freight-brokerage/#:~:text=Freight%20brokerage%20is%20a%20separate,own%20vehicles%20or%20storage%20facilities.
Managed Transportation / Transportation management	plays a vital role in the overall management of the supply chain by facilitating timely and cost-effective delivery of goods. It involves the systematic planning, execution, and control of the efficient flow of goods, services, and relevant information	*What Is Transportation Management In Supply Chain Management - Alibaba Cloud*. (n.d.). https://www.alibabacloud.com/topic-center/supply-chain/4ktlb6z7b7f-what-is-transportation-management-in-supply-chain-management

	from the starting point to the final destination of consumption.	
Port services	play a vital role in facilitating the smooth operation of various commercial activities at ports worldwide. These services encompass crucial functions such as cargo handling, providing nautical technical assistance like towage and berthing operations, as well as offering essential services like passenger transport and ship waste management.	Aukera, & Aukera. (2022, January 3). Port services: key instruments in maritime logistics - Bilogistik. *Bilogistik* -. https://www.bilogistik.com/en/blog/port-services-key-instruments-in-maritime-logistics/
Trade services/trade logistics	encompasses the comprehensive management process involving the seamless flow of goods and information between suppliers and companies, as well as between customers and companies. This term also refers to the internal movement of goods within a company's operations.	*What is Trade Logistics? Logistics Terms and Definitions	Saloodo!* (n.d.). Saloodo! https://www.saloodo.com/logistics-dictionary/trade-logistics/#:~:text=Trade%20logistics%20refers%20to%20the,the%20internal%20flow%20of%20goods.
Origin management	is a comprehensive solution that addresses origin-related challenges and enables companies operating in international markets to benefit from lower import duty rates. It leverages FTAs to gain a competitive advantage and gives companies the ability to respond quickly should there be new developments.	Van De Heetkamp, A., & Tusveld, R. (2011). Origin Management. In *Springer eBooks* (pp. 157–176). https://doi.org/10.1007/978-3-642-19808-3_11
Digitalized freight forwarding	is when companies mainly use digital technologies to coordinate and control the transportation of products. From tracking shipments and coordinating with suppliers and customers to documentation, they leverage technology to automate processes and support their business.	Haghdadeh, P. (2023, February 12). It's 2023 How Digital Freight Forwarding Help Us Save Money. DFreight. https://dfreight.org/blog/digital-freight-forwarding-modern-and-useful/#:~:text=The%20practice%20of%20coordinating%20and,managing%20documentation%20using%20internet%20tools.

Appendix B: Interview Questionnaire

Logistics Service Provider

1. What is the nature of your business?
2. Please describe your business model.
3. When was the company established (irrespective of integrations, mergers, acquisitions, and business expansion?
4. What services were offered when it was established?
5. How were other services established?
6. How did the company evolve into its current structure?
7. Was there any change in ownership since the company was established? Please describe this change
8. Among your existing customers, what is the approximate longest customer relationship in your company?
9. What do you think are the factors in sustaining this relationship?
10. What have been the biggest challenges in your company?
11. How do/did you address or how do you continue to address these challenges?
12. How do/did smart technologies address these challenges?
13. What is the reason for choosing these as the primary priority for the organization?
14. How did the implementation of these technologies impact your previous processes?
15. How about your resources?
16. Are there existing systems impacted? If yes, how?
17. How do you measure these impacts internally?
18. What was the impact of the adoption on your customer? How was this proven?

Appendix C: Research Protocol

Project Title

Logistics Service Providers' Adoption of Smart Technologies for Improved Customer

Project Summary

Logistics Service Providers, or LSP,s play a critical role in their customers' supply chain. The increasing complexity of global supply chains requires these firms to adopt smart technology to enable processes that satisfy the needs of these customers. Technological ubiquity and speed of its development have a dichotomous impact on LSPs. This project seeks to evaluate whether there are similar or different impacts for different types of LSPs. Our study aims to validate the literature that longevity and firm valuation of LSPs are factors that affect their technology adoption. We also seek to assess whether the LSPs' adoption of these technologies creates customer-perceived value. Finally, we intend to determine themes based on the factors gathered from LSPs and their customers that create a pathway that leads to more effective technology adoption. To gather information, we will conduct semi-structured interviews among various types of LSPs and their customers. We expect that this study will contribute to the supply chain management industry in both academia and practice.

Project Description

Rationale

Globalization has increased the complexity of modern supply chains. The internet promulgated the expansion of firms to a global market, allowing businesses of all sizes to penetrate remote areas. Consumers can now purchase products from anywhere in the world through computer applications or with the click of a button on their mobile devices. Geographical and industrial specialization has resulted in a world where products may be sourced from different locations. Equally, the cost of shipping goods worldwide has fallen to levels that product prices can absorb in destination markets (UNCTAD, 2015). This web market opened exponential growth in global transactions, and firms can now choose from a wide range of geographies to distribute their manufactured goods. To ensure competitive pricing and higher profitability for those goods, they can produce them using raw materials purchased at lower

prices outside their manufacturing countries. As processes become more and more complex, firms rely on other companies to manage their supply chain's logistical processes.

Objectives

We intend to study the factors contributing to customer value on Logistics Service Providers' technology adoption; if customers recognize the value of these technologies, these should increase LSP firm value. The emergence of industry disruptors or LSPs that primarily use technology to provide physical services proves that customers seek value that the LSPs cannot provide. The study aims to contribute to the theory by validating factors identified in extant literature that affected LSPs technology adoption. In addition, the research aims to define the pathway for practitioners on technology adoption that lead to customer value. The pathway may be used as actions that business leaders and decision-makers to prioritize which technologies they need to adopt, considering the number of technologies available in the market.

Methodology

Method

For this study, we will use field research among various types of LSPs to study the subject matter in context and use empirical evidence from more than one organization (Myers, 2020). This method is preferred as it explains how and why business decisions are made and why the process works the way it does (Yin, 2018).

The research design will follow replication logic for internal validity, wherein a series of interviews will be conducted to validate findings among several cases or through literal replication. This process is expected to identify common, contrasting, or altering the conditions of the original findings in the literature (Yin, 2018). This research design allows the authors to confirm and contrast the impact of LSPs technology adoption, wherein the unit of analysis is the organization.

Reliability and Validity

We will take several measures to ensure the reliability of our case data, the validity of our empirical concepts, and the external and internal validity of our analysis. Following Yin, 2018, we will improve reliability by 1) organizing case records for each firm in the same way, 2) taking notes during conversations, and 3) creating a case study database using Nvivo or Excel. Construct

validity will be enhanced by validating factors identified from interviews with firm representatives against their customers, for which the technology is implemented. The order of the process will and establish a chain of evidence for each case.

Sampling

To select the firms considered as one of the study cases, we focus on LSP organizations of varying sizes and lengths in business. We will employ a convenience sampling technique focusing on cases with whom the researchers have an existing relationship. To provide compelling support to the initial set of propositions, we will choose at least 6 to 10 aggregate cases to pursue different replication patterns, as suggested by Yin (2018). These organizations offer services in logistics outsourcing to customers, with or without contractual agreements.

Finally, we will gain insights through separate interviews with LSP's customers, for whom they have implemented smart technologies for outsourced services rendered to them. For each firm, we will interview at least one employee involved in tasks of functions necessary to the level of analysis.

Primary and Secondary Data

Data collection will be based primarily on semi-structured interviews following a protocol to increase the case's reliability. In addition, we will complement our data with a review of publicly available information on the LSP firm, including website information, published documentation, and industry-published information. We will follow a two-phased interview process: the initial interview will be an in-depth question-and-answer phase, and the final phase is for validation and verification of initial answers or additional comments or answers based on the initial interview.

Primary Data	
Interviews	Time expected to conduct interviews (30 minutes to1 hour length) per case
Informal dialogue	Through phone conversations or follow-up emails with the owner and functional managers.
Secondary data	
Documentation	Publicly available company information (financials, product literature, business plan, etc.)
Documentation	Industry and technology platform benchmarks

Data Collection Procedures

We will collect data from employees in these organizations through semi-structured interviews. Before the interview, we intend to review public information available about their organization. We will provide the firm representatives with a consent form to be mutually agreed upon between the interviewee and the interviewer. If required, we will provide a third-party waiver of confidentiality that states the objective of the research as a dissertation for completion of doctoral studies, for which our employer does not have any liability.

In addition to actual questions, in case we need to follow up with the interviewee to request additional documents or information, we will provide options on whether this will be sent through email or an actual conversation will be preferred. Whether in hard copies or electronic, documentary information will be used as part of our explicit data collection techniques to corroborate and augment information gathered during the interview (Yin, 2018).

Protocol Questions

The interview protocol questions start with general questions regarding the organization to establish the case's reliability. The next set of questions pertains to specific information about the interviewee to determine the employee's credibility in answering questions relevant to the case. The protocol questions will be used as a line of inquiry and not as a survey questionnaire, allowing the interviewees to expound based on their individual responses.

Attached is a list of semi-structured questions to be used for the interview process.

Interview%20Questionnaire%20_v2.doc›

Data Recording

The recordings for each interview will be recorded in either audio or video format. These will be stored in password-secured cloud storage for safekeeping and security. Upon publishing of findings, the recordings will be permanently deleted from the cloud storage.

Data Analysis:

The recordings of the interviews, along with publicly available information gathered, will be transcribed by a 3rd party transcription service. The transcripts were processed in two ways; a manual analysis and an automated analysis using NviVo.

For the manual analysis, each interviewee's response will be transcribed next to each question in an excel sheet, identifying key factors from the responses gathered. For the automated analysis, the transcripts will be transcribed by an outsourced party and uploaded to Nvivo. The coding will take place based on the interview questions. The responses were then passed through several NVivo analytic tools, including cluster analysis, network sociogram, and explore diagrams, to identify common themes across the interviews.

Based on these themes, we expect to draw conclusions to the research question and propose theoretical and managerial implications.

Ethical Considerations

There were no ethical considerations necessary for the research.

Gender Issues

We anticipate no gender issues in the course of the research.

References

Appendix D: Informed Consent

Georgia State University

Informed Consent

Title: **Logistics Service Providers' Adoption of Smart Technologies for Improved Customer Value**
Principal Investigator: Denish Shah, Ph.D.
Student Principal Investigator: Raziel Bravo, MBA

You are being asked to participate in a research study based on your involvement in outsourced logistics services as a part of a logistics service provider's (LSP) organization or as a customer of an LSP. The purpose of the study is to gather factors leading to smart technology adoption of the LSPs to improve customer value to increase the firm value for both organizations.

If you decide to participate, you will be requested to provide information about your role and details of your organization. These will allow us to gather information for our research.

If you agree to participate, we will schedule an interview with you virtually or in person. We will set the schedule at a time convenient for you. Before the interview schedule, we will provide you with a questionnaire. You may invite other participants from your organization who can provide additional information about this research. Other participants you invite must sign a separate consent form.

The initial session will last from 30 minutes to one hour. Suppose a follow-up communication is necessary for clarification or additional information. In that case, we will send an email or schedule a phone call or video conference in less than 30 minutes.

Participating in this study will not expose you to any more risks than you would experience on a typical day. This study is not designed to benefit you or your organization. We hope to gain information to benefit society by contributing to the supply chain industry.

You may opt-out of the interview even after signing this consent or before the scheduled interview. During the interview process, you may choose to skip certain questions or stop the interview session at any time.

We will record the interview via audio and video for transcription and coding. While recording is going on, the researchers will also take down important notes electronically. We will secure all recordings and related documentation in password-protected cloud storage for this study from November 2022 to March 2023. After publishing the study results, we will permanently delete these recordings and the related documentation.

We will keep your records private to the extent allowed by law. Only the following people and entities will have access to the information you provide:

- Denish Shah, Ph. D. (Principal Investigator) and Raziel Bravo (Student Principal Investigator)
- GSU Institutional Review Board
- Office for Human Research Protection (OHRP)

The details you provide about you and your company will remain confidential and will not appear in any published documents.

For any information exchange using email, you should be aware that data sent over the Internet may not be secure. You may use encryption or other mechanisms to exchange sensitive information with the researchers. On our end, we will use encrypted emails to request, comment, or clarify information with you.

For any questions and clarifications about the study or your part in it, you may contact Denish Shah, Ph.D., MBA (Principal Investigator) at email address: shah@gsu.edu or Phone Number +1(860)478-9144, or Raziel Bravo, MBA (Student Principal Investigator at email address: rbravo1@student.gsu.edu or Phone Number +1(714)235-3057/+1(310)486-9865

The Institutional Review Board (IRB) at Georgia State University reviews all research that involves human participants. Suppose you would like to speak to someone not involved directly with the study. In that case, you can contact the IRB for questions, concerns, problems, information, input, or questions about your rights as a research participant. Contact the IRB at 404-413-3500 or irb@gsu.edu.

If you are willing to participate in this research, please sign below. We will provide a signed copy of this consent form for your reference.

_____

Printed Name of Participant

_____ _____

Signature of Participant Date

_____ _____

Principal Investigator or Researcher Obtaining Consent Date

REFERENCES

Ahmad, R., Salah, K., Jayaraman, R., Yaqoob., I., Omar, M., & Samer, E. (2021). Blockchain-Based Forward Supply Chain and Waste Management for COVID-19 Medical Equipment and Supplies | IEEE Journals & Magazine | IEEE Xplore. *IEEE Access*, *9*. https://ieeexplore.ieee.org/abstract/document/9380312/

Ajzen, I. (1991). The theory of planned behavior—ScienceDirect. *Organizational Behavior and Human Decision Processes*, *50*(179–211). https://www.sciencedirect.com/science/article/abs/pii/074959789190020T

Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, *2*. https://doi.org/10.1002/hbe2.195

Akhilesh, K. B. (2020). *Smart Technologies—Scope and Applications*. https://link.springer.com/chapter/10.1007/978-981-13-7139-4_1

Akkaya, M., & Kaya, H. (2019, October). *Innovative and smart technologies in logistics*. 17th International and Logistics Supply Chain Congress, Istantbul Turkey.

Alkhatib, S. F. (2017). Strategic logistics outsourcing: Upstream-downstream supply chain comparison | Emerald Insight. *Jornal of Global Operations and Strategic Sourcing*. https://www.emerald.com/insight/content/doi/10.1108/JGOSS-08-2016-0024/full/html

Alkhatib, S. F., Darlington, R., Yang, Z., & Nguyen, T. T. (2015). A novel technique for evaluating and selecting logistics service providers based on the logistics resource view. *Expert Systems with Applications*, *42*(20), 6976–6989. https://doi.org/10.1016/j.eswa.2015.05.010

Allotey, P. (2008). Travelling with “Excess Baggage”: Health Problems of Refugee Women in Western Australia: Women & Health: Vol 28, No 1. *Women & Health*, *28*(1), 63–81.

Al-Mamary, Y. H., Shamsuddin, A., & Aziati, N. (2013). The_Impact_of_Management_Information_Sys (1).pdf. *Management Information System*, *8*(4), 010–017.

AlMulhim, aBDULLAH fAHAD. (2021). Smart supply chain and firm performance: The role of digital technologies | Emerald Insight. *Business Process Management Journal*, *2*(5). https://www.emerald.com/insight/content/doi/10.1108/BPMJ-12-2020-0573/full/html

Al-Suqri, M. N., & Al-Kharusi, R. M. (2015). *Ajzen and Fishbein's Theory of Reasoned Action (TRA) (1980)* [Chapter]. Information Seeking Behavior and Technology Adoption: Theories and Trends; IGI Global. https://doi.org/10.4018/978-1-4666-8156-9.ch012

Aravindaraj, K., & Rajan Chinna, P. (2022). A systematic literature review of integration of industry 4.0 and warehouse management to achieve Sustainable Development Goals. *Cleaner Logistics and Supply Chain*. https://www.sciencedirect.com/science/article/pii/S2772390922000452

Atayah, O. F., Dhiaf, M. M., & Federico, G. F. (2022, May). *Impact of COVID-19 on financial performance of logistics firms: Evidence from G-20 countries | Emerald Insight*. https://www.emerald.com/insight/content/doi/10.1108/JGOSS-03-2021-0028/full/html

Atwani, M., Hiyal, M., & Elalami. (2022). *A Review of Artificial Intelligence applications in Supply Chain | ITM Web of Conferences*. *46*. https://www.itm-conferences.org/articles/itmconf/abs/2022/06/itmconf_iceas2022_03001/itmconf_iceas2022_03001.html

Baker, J. (2012). The Technology–Organization–Environment Framework. In Y. K. Dwivedi, M. R. Wade, & S. L. Schneberger (Eds.), *Information Systems Theory* (Vol. 28, pp. 231–245). Springer New York. https://doi.org/10.1007/978-1-4419-6108-2_12

Barreto, L., Amaral, A., & Pereira, T. (2017). Industry 4.0 implications in logistics: An overview. *Procedia Manufacturing*, *13*, 1245–1252. https://doi.org/10.1016/j.promfg.2017.09.045

Benarbia, T., & Kyamakya, K. (2021). A Literature Review of Drone-Based Package Delivery Logistics Systems and Their Implementation Feasibility. *Sustainability*, *14*(1), 360. https://doi.org/10.3390/su14010360

Bhatti, A., Akram, H., Basit, H. M., Khan, A. U., Raza, S. M., & Bilal, M. (2020). E-commerce trends during COVID-19 Pandemic. *International Journal of Future Generation Communication and Networking*, *13*(2), 5.

Bigliardi, B., Casella, G., & Bottani, E. (2021). Industry 4.0 in the logistics field: A bibliometric analysis. *IET Collaborative Intelligent Manufacturing*, *3*(1), 4–12. https://doi.org/10.1049/cim2.12015

Bolumole, Y. A., Frankel, R., & Naslund, D. (2022). *Developing a Theoretical Framework for Logistics Outsourcing*. 21.

Borgström, B., Hertz, S., & Jensen, L.-M. (2021). Strategic development of third-party logistics providers (TPLs): "Going under the floor" or "raising the roof"? *Industrial Marketing Management*, *97*, 183–192. https://doi.org/10.1016/j.indmarman.2021.07.008

Boysen, N., De Koster, R., & Weidinger, F. (2019). Warehousing in the e-commerce era: A survey. *European Journal of Operational Research*, *277*(2), 396–411. https://doi.org/10.1016/j.ejor.2018.08.023

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2013). *Teaching Thematic Analysis*.

Bravo, R., Gonzalez Segura, M., Temowo, O., & Samaddar, S. (2022). How Does a Pandemic Disrupt the Benefits of eCommerce? A Case Study of Small and Medium Enterprises in the US. *Journal of Theoretical and Applied Electronic Commerce Research*, *17*(2), 522–557. https://doi.org/10.3390/jtaer17020028

Busse, C., & Marcus Wallenburg, C. (2011). Innovation management of logistics service providers: Foundations, review, and research agenda. *International Journal of Physical Distribution & Logistics Management*, *41*(2), 187–218. https://doi.org/10.1108/09600031111118558

Bvepfepfe, B., Suri, A. khan, & El Asad, A. (2019). Adoption of Emerging Technologies in Supply Chain Operations for Cost Reduction and Enhancement of Shareholder Wealth: A Case Study of UAE Organization. *Advances in Internet Data and Web Technologies*, *29*, 437–449. https://link.springer.com/chapter/10.1007/978-3-030-12839-5_40?error=cookies_not_supported&code=fdcee69b-ad41-456d-863a-5ec77e7c7a97

Byrne, D. (2021). *A worked example of Braun and Clarke's approach to reflexive thematic analysis | SpringerLink*. https://link.springer.com/article/10.1007/s11135-021-01182-y?error=cookies_not_supported&code=44c4d3f0-c404-47fe-970b-8afad07f7a42

Ceniga, P., & Sukalova, V. (2015). Future of Logistics Management in the Process of Globalization. *Procedia Economics and Finance*, *26*, 160–166. https://doi.org/10.1016/S2212-5671(15)00908-9

Cheung, K.-F., Bell, M. G. H., & Bhattacharjya, J. (2021). Cybersecurity in logistics and supply chain management: An overview and future research directions. *Transportation Research Part E: Logistics and Transportation Review*, *146*, 102217. https://doi.org/10.1016/j.tre.2020.102217

Cho, G.-S. (2018). A Study on Establishment of Smart Logistics Center based on Logistics 4.0. *Journal of Multimedia Information System*, *5*(4), 265–272. https://doi.org/10.9717/JMIS.2018.5.4.265

Cho, S. P., & Kim, J. (2017). Smart Logistics Model on Internet of Things Environment. *Advanced Science Letters*, *23*(3), 1599–1602.

Chung, S. H. (2021). Applications of smart technologies in logistics and transport: A review. *Transportation Research Part E: Logistics and Transportation Review*, *153*, 102455.

Cichosz, M., Wallenburg, C. M., & Knemeyer, A. M. (2020). Digital transformation at logistics service providers: Barriers, success factors and leading practices. *The International Journal of Logistics Management*, *31*(2), 209–238. https://doi.org/10.1108/IJLM-08-2019-0229

Cimini, C., Lagorio, A., Romero, D., Cavalieri, S., & Stahre, J. (2020a). Smart Logistics and The Logistics Operator 4.0. *IFAC-PapersOnLine*, *53*(2), 10615–10620. https://doi.org/10.1016/j.ifacol.2020.12.2818

Cimini, C., Lagorio, A., Romero, D., Cavalieri, S., & Stahre, J. (2020b). *Smart Logistics and The Logistics Operator 4.0*.

Dash., R., McMurtrey, M., Rebman, C., & Kar, U. (2019). Application of artificial intelligence in automation of supply chain management. *Journal of Strategic Innovation and Sustainability*, *14*(3), 43–53.

Davis, F., & Viswanath, V. (1996). A critical assessment of potential measurement biases in the technology acceptance model: Three experiments—ScienceDirect. *International Journal of Human Computer Studies*, *45*(1), 19–45.

de Vass, T., Shee, H., & MIah, S. (2018). The effect of "Internet of Things" on supply chain integration and performance: An organisational capability perspective | Australasian Journal of Information Systems. *Australasian Journal of Information Systems*, *22*. https://journal.acs.org.au/index.php/ajis/article/view/1734

Dekhne, A., Hastings, G., & Neuhaus. (2019). Automation in logistics. *McKinsey Q*, *24*.

Deloitte United States. (2022, July 13). *Using Blockchain to drive supply chain transparency and Innovation*. https://www2.deloitte.com/us/en/pages/operations/articles/blockchain-supply-chain-innovation.html

Dong, Z. (2021). Construction of Mobile E-Commerce Platform and Analysis of Its Impact on E-Commerce Logistics Customer Satisfaction. *Complexity*, *2021*, e6636415. https://doi.org/10.1155/2021/6636415

DOUAIOUI, K., FRI, M., MABROUKKI, C., & SEMMA, E. A. (2018). The interaction between industry 4.0 and smart logistics: Concepts and perspectives. *2018 International Colloquium on Logistics and Supply Chain Management (LOGISTIQUA)*, *00212667984883*, 128–132. https://doi.org/10.1109/LOGISTIQUA.2018.8428300

DP-DHL finally abandons ill-fated NFE IT project and is forced to write off €345m—The Loadstar. (n.d.). Retrieved June 13, 2022, from https://theloadstar.com/dp-dhl-finally-abandons-ill-fated-nfe-it-project-and-is-forced-to-write-off-e345m/

Evangelista, P., McKinnon, A., & Sweeney, E. (2013). Technology adoption in small and medium-sized logistics providers. *Industrial Management & Data Systems*, *113*(7), 967–989. https://doi.org/10.1108/IMDS-10-2012-0374

Excess baggage Definition & Meaning | Dictionary.com. (n.d.). Retrieved June 4, 2023, from https://www.dictionary.com/browse/excess-baggage

Excess baggage definition and meaning | Collins English Dictionary. (n.d.). Retrieved June 4, 2023, from https://www.collinsdictionary.com/us/dictionary/english/excess-baggage

excess-baggage noun—Definition, pictures, pronunciation and usage notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com. (n.d.). Retrieved June 4, 2023, from https://www.oxfordlearnersdictionaries.com/us/definition/english/excess-baggage

Ezzat, M., Kassem, S., & Abd Elkader, M. (2019). *Logistics 4.0: Definition and Historical Background*. https://doi.org/10.1109/NILES.2019.8909314

Fayad, R., & Paper, D. (2015). A critical assessment of potential measurement biases in the technology acceptance model: Three experiments—ScienceDirect. *Procedia Economics and Finance*, *26*, 1000–1006.

Feng, B., & Ye, Q. (2021). Operations management of smart logistics: A literature review and future research. *Frontiers of Engineering Management*, *8*(3), 344–355. https://doi.org/10.1007/s42524-021-0156-2

Fishbein, M. (2008). *Reasoned Action, Theory of—Fishbein—Major Reference Works—Wiley Online Library*. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781405186407.wbiecr017

Frazzon, E. M., Rodriguez, C. M. T., Pereira, M. M., Pires, M. C., & Uhlmann, I. (2019). Towards Supply Chain Management 4.0 |. *Brazilian Journal of Operations & Production Management*, *16*(2), 180–191.

Frederico, G. F. (2021). From Supply Chain 4.0 to Supply Chain 5.0: Findings from a Systematic Literature Review and Research Directions. *Logistics*, *5*(3), 49. https://doi.org/10.3390/logistics5030049

Fulconis, F., & Paché, G. (2018). Supply Chain Monitoring: LLPs and 4PL Providers as Orchestrators. *Procedia - Social and Behavioral Sciences*, *238*, 9–18. https://doi.org/10.1016/j.sbspro.2018.03.002

Galindo, L. D. (2016). *The Challenges of Logistics 4.0 for the Supply Chain Management and the Information Technology*. 96.

George, A. S., & George, A. s. H. (2020). Industrial revolution 5.0: The transformation of the modern manufacturing process to enable man and machine to work hand in hand. *Journal of Seybold Report*.

Getting I.T. Right: What forwarders can learn from DHL's struggle | Air Cargo World. (n.d.). Retrieved June 13, 2022, from https://aircargoworld.com/news/technology/getting-i-t-right-what-forwarders-can-learn-from-dhls-struggle/

Giraldo-Diaz, J. M., & Fuerst, S. (2019). Shipstra: The lean start-up of a digital freight-forwarding marketplace. *Global Business and Organizational Excellence*, *38*(5), 6–17. https://doi.org/10.1002/joe.21946

Graf, A., & Maas, P. (2008). Customer value from a customer perspective: A comprehensive review. *Journal Für Betriebswirtschaft*, *58*(1), 1–20. https://doi.org/10.1007/s11301-008-0032-8

Gromovs, G., & Lammi, K. (2017). Blockchain and internet of things require innovative approach to logistics education. *Transport Problems*, *12*, 23–34.

Gupta, S., Drave, V. A., Bag, S., & Luo, Z. (2019). Leveraging Smart Supply Chain and Information System Agility for Supply Chain Flexibility. *Information Systems Frontiers*, *21*, 547–564.

Hanus, P. (2013). *THE BUSINESS PROFILE SHAPING AND THE LOGISTICS INFORMATION SYSTEMS OF 2PL, 3PL, 4PL OPERATORS*.

Hardy, L. (2003). Quantum ontological excess baggage—ScienceDirect. *Studies Oin History and Philosophy of Modern Physics*, *35*, 267–276.

Hartle, J. (2005). Excess Baggage. *General Relativity and Quantum Cosmology*, *1*. https://arxiv.org/abs/gr-qc/0508001

Hazen, B. T., & Byrd, T. A. (2012). Toward creating competitive advantage with logistics information technology. *International Journal of Physical Distribution & Logistics Management*, *42*(1), 8–35. http://dx.doi.org/10.1108/09600031211202454

Helo, P., & Shamsuzzoha, A. H. M. (2020). Real-time supply chain—A blockchain architecture for project deliveries. *Robotics and Computer-Integrated Manufacturing*, *63*(101909). https://www.sciencedirect.com/science/article/pii/S0736584518306665?casa_token=IhT4bnpwtQcAAAAA:iXJBh0d3Xfag4JPMyv1Ke16HxyLy1Khk30Zi5Rf2TxFQw9mM4X4FWKoIQ2mAtKKeaw962XboA6B1

Hofmann, E., & Osterwalder, F. (2017). Third-Party Logistics Providers in the Digital Age: Towards a New Competitive Arena? *Logistics*, *1*(2), Article 2. https://doi.org/10.3390/logistics1020009

Holnicki-Szulc, J., Motylewski, J., & Kołłakowski, P. (2008). Introduction to smart technologies. In *Smart Technologies for Safety Engineering* (pp. 1–10). Wiley.

Hopp, C., Antons, D., Kaminski, J., & Oliver Salge, T. (2018). Disruptive Innovation: Conceptual Foundations, Empirical Evidence, and Research Opportunities in the Digital Age. *Journal of Product Innovation Management*, *35*(3), 446–457. https://doi.org/10.1111/jpim.12448

Hu, S. J. (2013). Evolving Paradigms of Manufacturing: From Mass Production to Mass Customization and Personalization. *Procedia CIRP*, *7*, 3–8. https://doi.org/10.1016/j.procir.2013.05.002

Hunaid, M., BhurgrI, A. A., & Shaikh, A. (2020). Supply Chain Visibility in Leading Organizations of the Shipping Industry: Supply Chain in Shipping Industry. *South Asian Journal of Social Review (ISSN: 2958-2490)*, *1*(1). http://journal.sagpb.com/index.php/SAJSR/article/view/20

Hussain, M., Javed, W., Hakeem, O., Yousafzai, A., Younas, A., Awan, M. J., Nobanee, H., & Zain, A. M. (2021). Blockchain-Based IoT Devices in Supply Chain Management: A Systematic Literature Review. *Sustainability*, *13*(24). https://www.mdpi.com/2071-1050/13/24/13646

It's a Small World—Wikipedia. (n.d.). Retrieved May 26, 2023, from https://en.wikipedia.org/wiki/It%27s_a_Small_World

Jafari, N., Azarian, M., & Yu, H. (2022). Moving from Industry 4.0 to Industry 5.0: What Are the Implications for Smart Logistics? *Logistics*, *6*(2), 26. https://doi.org/10.3390/logistics6020026

Jagtap, S., Garcia-Garcia, G., Trollman, H., & Salonitis, K. (2020). Food Logistics 4.0: Opportunities and Challenges. *Logistics*, *5*(1). https://www.mdpi.com/2305-6290/5/1/2

Jarašūnienė, A., Čižiūnienė, K., & Čereška, A. (2023). Research on Impact of IoT on Warehouse Management. *Sensors*, *23*(4). https://www.mdpi.com/1424-8220/23/4/2213

Kalkha, H., Bahnasse, A., & Ouajji, H. (2023). The Rising Trends of Smart E-Commerce Logistics. *IEEE Access*. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10058951

Kawa, A. (2012). SMART Logistics Chain. In J.-S. Pan, S.-M. Chen, & N. T. Nguyen (Eds.), *Intelligent Information and Database Systems* (Vol. 7196, pp. 432–438). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-28487-8_45

Kawa, A., Pawlewski, P., Golinska, P., & Hajdul, M. (2010). *Cooperative Purchasing of Logistics Services among Manufacturing Companies Based on Semantic Web and Multi-agent System* (Vol. 71, p. 256). https://doi.org/10.1007/978-3-642-12433-4_30

Kersten, W., Blecker, T., & Ringle, C. (2017). *Digitalization in supply chain management and logistics: Smart and digital solutions for an industry 4.0 environment*. ePubli GmbH.

Kim, C., Yang, K., & Kim, J. (2008). A strategy for third-party logistics systems: A case analysis using the blue ocean strategy☆. *Omega*, *36*(4), 522–534. https://doi.org/10.1016/j.omega.2006.11.011

Kindsiko, E., & Poltimae, H. (2019). *Forum Qualitative Sozialforschung (Social Research)*. *20*(3). https://www.qualitative-research.net/index.php/fqs/article/download/3200/4422?inline=1

Kiradoo, D. G. (2020). *A STUDY ON MANAGEMENT INFORMATION SYSTEMS ROLE AND ADOPTION IN MANAGERIAL DECISION MAKING*.

Klumpp, M., & Loske, D. (2021). Sustainability and Resilience Revisited: Impact of Information Technology Disruptions on Empirical Retail Logistics Efficiency. *Sustainability*, *13*(10), Article 10. https://doi.org/10.3390/su13105650

Kumar, D., Singh, R., & Mishra, R. (2020). Applications of the internet of things for optimizing warehousing and logistics operations: A systematic literature review and future research directions. *Computers & Industrial Engineering*, *171*. https://www.sciencedirect.com/science/article/pii/S0360835222004892?casa_token=irNC

HINv6pcAAAAA:FoilfbnQK_J0Uj0Pd8hcgvrF8haS0q31Z4_YHE4QO9b2kuUrqSuVpWZtWAkYg_iDnRsirtL-AG8j

Lai, K. (2004). Service capability and performance of logistics service providers. *Transportation Research Part E: Logistics and Transportation Review*, *40*(5), 385–399. https://doi.org/10.1016/j.tre.2004.01.002

Lai, K., Edwin Cheng, T. C., & Yeung, A. C. L. (2004). An Empirical Taxonomy for Logistics Service Providers. *Maritime Economics & Logistics*, *6*(3), 199–219. https://doi.org/10.1057/palgrave.mel.9100109

Lin, C.-Y. (2008). Determinants of the adoption of technological innovations by logistics service providers in China. *International Journal of Technology Management & Sustainable Development*, *7*(1), 19–38. https://doi.org/10.1386/ijtm.7.1.19_1

Liu, W., Hou, J., Yan, X., & Tang, O. (2021a). Smart logistics transformation collaboration between manufacturers and logistics service providers: A supply chain contracting perspective. *Journal of Management Science and Engineering*, *6*(1), 25–52. https://doi.org/10.1016/j.jmse.2021.02.007

Liu, W., Hou, J., Yan, X., & Tang, O. (2021b). Smart logistics transformation collaboration between manufacturers and logistics service providers: A supply chain contracting perspective. *Journal of Management Science and Engineering*, *6*(1), 25–52. https://doi.org/10.1016/j.jmse.2021.02.007

Liu, W., Liang, Y., Wei, S., & Wu, P. (2021). The organizational collaboration framework of smart logistics ecological chain: A multi-case study in China. *Industrial Management & Data Systems*, *121*(9), 2026–2047.

Liu, W., Long, S., Liang, Y., Wang, J., & Wei, S. (2021). The influence of leadership and smart level on the strategy choice of the smart logistics platform: A perspective of collaborative innovation participation. *Annals of Operations Research*. https://doi.org/10.1007/s10479-021-04063-7

Liu, X., McKinnon, A. C., Grant, D. B., & Feng, Y. (2010). Sources of competitiveness for logistics service providers: A UK industry perspective. *Logistics Research, 2*(1), 23–32. https://doi.org/10.1007/s12159-010-0024-7

MacGregor, R., & Vrazalic, L. (2005). A basic model of electronic commerce adoption barriers. *Journal of Small Business and Enterprise Development, 12*(4), 510.

Maersk. (2022, December 1). *Information on the closure of TradeLens | Maersk*. https://www.maersk.com/news/articles/2022/12/01/information-on-the-closure-of-tradelens

Marchet, G., Melacini, M., Perotti, S., Sassi, C., & Tappia, E. (2017). Value creation models in the 3PL industry: What 3PL providers do to cope with shipper requirements. *International Journal of Physical Distribution & Logistics Management, 47*(6), 472–494. https://doi.org/10.1108/IJPDLM-04-2016-0120

Markov, K., & Vitliemov, P. (2020, May 14). Logistics 4.0 and supply chain 4.0 in the automotive industry. *IOP Conference Series: Materials Science and Engineering*. 9TH INTERNATIONAL SCIENTIFIC CONFERENCE “TechSys 2020” – ENGINEERING, TECHNOLOGIES AND SYSTEMS, Plovdiv, Bulgaria. https://iopscience.iop.org/article/10.1088/1757-899X/878/1/012047/meta

Mathauer, M., & Hofmann, E. (2019). Technology adoption by logistics service providers. *International Journal of Physical Distribution & Logistics Management*, *49*(4), 416–434. http://dx.doi.org/10.1108/IJPDLM-02-2019-0064

M'hand, M. A., Boulmakoul, A., Badir, H., & Lbath, A. (2019). A scalable real-time tracking and monitoring architecture for logistics and transport in RoRo terminals. *Procedia Computer Science*, *151*, 218–225.

Mikl, J., Herold, D. M., Ćwiklicki, M., & Kummer, S. (2021). **The impact of digital logistics start-ups on incumbent firms**: **A business model perspective**. *The International Journal of Logistics Management*, *32*(4), 1461–1480. https://doi.org/10.1108/IJLM-04-2020-0155

Mikl, J., Herold, D. M., Pilch, K., Ćwiklicki, M., & Kummer, S. (2021). Understanding disruptive technology transitions in the global logistics industry: The role of ecosystems. *Review of International Business and Strategy*, *31*(1), 62–79. https://doi.org/10.1108/RIBS-07-2020-0078

Miles, M. B., Huberman, M., & Saldana, J. (2020). *Qualitative Data Analysis* (4th ed.). Sage Publications Ltd.

Mishra, S., & Tyagi, A. K. (2022). The Role of Machine Learning Techniques in Internet of Things-Based Cloud Applications. In *Artificial Intelligence-based Internet of Things Systems. Internet of Things.* (pp. 105–135). https://link.springer.com/chapter/10.1007/978-3-030-87059-1_4?error=cookies_not_supported&code=7991e971-8a90-4981-967d-a386e1d47ae9

Mostafa, N., & Hamdy, W. (2018, September 27). Towards a smart warehouse management system. *Proceedings of the International Conference on Industrial Engineering and Operations Management*.

Mostafa, N., Hamdy, W., & Alawady, H. (2019). Impacts of internet of things on supply chains: A framework for warehousing. *Social Sciences*, *8*(3).

Myers, M. (2020). Data Collection Techniques. In *Qualitative Research in Business Management* (3rd ed.). Sage Publications Ltd.

Nadeem, W., Juntunen, M., Hajli, N., & Tajvidi, M. (2019). The Role of Ethical Perceptions in Consumers' Participation and Value Co-creation on Sharing Economy Platforms | SpringerLink. *Journal of Business Ethics*, *169*, 421–441.

Nahr, J. G., Nozari, H., & Sadeghi, M. E. (2021). Green supply chain based on artificial intelligence of things (AIoT). *International Journal of Innovation in Management, Economics and Social Sciences*, *1*(2), 56–63.

Nasiri, M., Ukko, J., & Rantala, T. (2020). *Managing the digital supply chain: The role of smart technologies—ScienceDirect*. https://www.sciencedirect.com/science/article/pii/S0166497220300110

Noruzi, A. (2005). Google Scholar: The New Generation of Citation Indexes. *Libri*, *55*(4). https://doi.org/10.1515/LIBR.2005.170

Oleskow-Szlapka, J., Stachowiak, A., Pawłowski, G., & Maruszewska, K. (2018). Identification of Logistics 4.0 maturity levels in polish companies – framework of the model and preliminary research. *Industrial Internet of Things and Smart Manufacturing*.

Oliveira, T., & Martins, M. F. (2011). *Literature Review of Information Technology Adoption Models at Firm Level*. *14*(1), 12.

Panayides, P. M., & So, M. (2005). Logistics service provider–client relationships. *Transportation Research Part E: Logistics and Transportation Review*, *41*(3), 179–200. https://doi.org/10.1016/j.tre.2004.05.001

Pandey, S., Singh, R. K., Anggapa, G., & Kaushik, A. (2020). Cyber security risks in globalized supply chains: Conceptual framework. *Journal of Global Operations and Strategic Sourcing.*, *13*(1).

Pandian, A. (2019). Artificial intelligence application in smart warehousing environment for automated logistics. *Journal of Artificial Intelligence*, *01*(02), 63–72.

Papadopoulou, C., & Macbeth, D. K. (1998). Third Party Logistics Evolution: Lessons from the Past. *Supply Chain*, 11.

Parasuraman, A. (1997). Reflections on gaining competitive advantage through customer value. *Journal of the Academy of Marketing Science*, *25*(2), 154–161. https://doi.org/10.1007/BF02894351

Paul, S., Chatterjee, A., & Guha, D. (2019). Study of smart inventory management system based on the internet of things (IOT). *International Journal on Recent Trends in Business and Tourism (IJRTBT)*, *3*(3), 128–138.

Perdana, T., Handayati, Y., Sadeli, A., Utomo, D. S., & Hermiatin, F. R. (2020). A Conceptual Model of Smart Supply Chain for Managing Rice Industry. *Mimbar Jurnal Sosial Dan Pembangunan*, *36*(1), 128–138.

Poli, G. A., Saviani, T. N., & Júnior, I. G. (2018). LOGISTICS 4.0: A SYSTEMATIC REVIEW. . . *Vol.*, *26*, 16.

Power, D., Sharafali, M., & Bhakoo, V. (2007). Adding value through outsourcing: Contribution of 3PL services to customer performance. *Management Research News*, *30*(3), 228–235. https://doi.org/10.1108/01409170710733296

Premkumar, P., Gopinath, S., & Mateen, A. (2021). Trends in third party logistics – the past, the present & the future. *International Journal of Logistics Research and Applications*, *24*(6), 551–580. https://doi.org/10.1080/13675567.2020.1782863

Raj, P. V. R. P., Jauhar, S. L., Ramkumar, M., & Pratap, S. (2022). Procurement, traceability and advance cash credit payment transactions in supply chain using blockchain smart contracts. *Computers & Industrial Engineering*, *167*(108038).

Raja Santhi, A., & Muthuswamy, P. (n.d.). Influence of Blockchain Technology in Manufacturing Supply Chain and Logistics. *Logistics*, *6*(1), 15.

Ralston, P., & Blackhurst, J. (2020). Industry 4.0 and resilience in the supply chain: A driver of capability enhancement or capability loss? *International Journal of Production Research*, *58*(16), 5006–5019.

Razzaque, M. A., & Sheng C.C. (1998). Outsourcing of logistics functions: A literature survey | Emerald Insight. *International Journal of Physical Distribution & Logistics Management*, *285*(2), 89–107.

Rejeb, A., Keogh, J., & Treiblmaier, H. (2019). Leveraging the Internet of Things and Blockchain Technology in Supply Chain Management. *Future Internet*, *11*(7). https://www.mdpi.com/1999-5903/11/7/161

Riahi, Y., Saikouk, T., & Gunasekaran, A. (2021). Artificial intelligence applications in supply chain: A descriptive bibliometric analysis and future research directions. *Expert Systems with Applications*, *173*.

https://www.sciencedirect.com/science/article/pii/S0957417421001433?casa_token=GJuBsJatXIYAAAAA:GA90oyI_ngKc021gIhRZeUlAP4kEEbcwKdCkWPfOEHKPOxvBqiwkotBi10wd79wpMXBaikoWA3JI

Rodrigue, J.-P. (2020). The distribution network of Amazon and the footprint of freight digitalization. *Journal of Transport Geography*, *88*.

Sader, S., Husti, I., & Daroczi, M. (2022). A review of quality 4.0: Definitions, features, technologies, applications, and challenges. *Total Quality Management & Business Excellence*, *33*(9–10), 1164–1182. https://doi.org/10.1080/14783363.2021.1944082

SAP: Don't blame us for DHL's logistics woes | Computerworld. (n.d.). Retrieved June 13, 2022, from https://www.computerworld.com/article/3010496/sap-dont-blame-us-for-dhls-logistics-woes.html

Saunila, M., Nasiri, M., Ukko, J., & Rantala, T. (2019). Smart technologies and corporate sustainability: The mediation effect of corporate sustainability strategy. *Computers in Industry*, *108*, 178–185.

Saw, W. P. (2012). *The Evolution of the U.S. Logistics Outsourcing Industry: An Organizational Ecology Perspective*.

Schramm, H.-J., Czaja, C., Dittrich, M., & Mentschel, M. (2019). Current Advancements of and Future Developments for Fourth Party Logistics in a Digital Future. *Logistics*, *3*(1), 7. https://doi.org/10.3390/logistics3010007

Segrest, R. (2013). Design and the Pedagogical Text (Excess Baggage): *Journal of Architectural Education:*, *45*(1), 11–14.

Seidel, S., & Berente, N. (2020). Automate, informate, and generate: Affordance primitives of smart devices and the Internet of Things in: Handbook of Digital Innovation. In

Handbook of digital innovation (pp. 198–210). Elgar Publishing. https://www.elgaronline.com/display/edcoll/9781788119979/9781788119979.00024.xml

Selviaridis, K. (2016). Contract functions in service exchange governance: Evidence from logistics outsourcing. *Production Planning & Control*, *27*(16), 1373–1388. https://doi.org/10.1080/09537287.2016.1224397

Sheffi, Y. (1990). Third Party Logistics: Present and Future Prospects. *Journal of Business Logistics*, *11*(2), 27.

Siddiqi, S., & Sharan, A. (2015). Keyword and Keyphrase Extraction Techniques: A Literature Review. *International Journal of Computer Applications*, *109*(2), 18–23. https://doi.org/10.5120/19161-0607

Silva, P. (2015). *Davis' Technology Acceptance Model (TAM) (1989)* [Chapter]. Information Seeking Behavior and Technology Adoption: Theories and Trends; IGI Global. https://doi.org/10.4018/978-1-4666-8156-9.ch013

Sinkovics, R. R., Kuivalainen, O., & Roath, A. S. (2018). Value co-creation in an outsourcing arrangement between manufacturers and third party logistics providers: Resource commitment, innovation and collaboration. *Journal of Business & Industrial Marketing*, *33*(4), 563–573. https://doi.org/10.1108/JBIM-03-2017-0082

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sohn, J.-I., Woo, S.-H., & Kim, T.-W. (2017). Assessment of logistics service quality using the Kano model in a logistics-triadic relationship. *The International Journal of Logistics Management*, *28*(2), 680–698. https://doi.org/10.1108/IJLM-09-2015-0172

Sorooshian, S., Khademi Sharifabad, S., Parsaee, M., & Afshari, A. R. (2022). Toward a Modern Last-Mile Delivery: Consequences and Obstacles of Intelligent Technology. *Applied System Innovation*, *5*(4), 82.

Stefansson, G. (2006). Collaborative logistics management and the role of third-party service providers. *International Journal of Physical Distribution & Logistics Management*, *36*(2), 76–92. https://doi.org/10.1108/09600030610656413

Straka, M. (2019). Support Process of Distribution and Supply Logistics. In *Distribution and supply logistics* (pp. 72–123). Cambridge Scholars Publishing.

Syed, R., Suriadi, S., Adams, M., Bandara, W., Leemans, S. J. J., Ouyang, C., ter Hofsteded, A. H. M., van de Weerd, I., Wynn, M. T., & Reijers, H. A. (2020). Robotic Process Automation: Contemporary themes and challenges—ScienceDirect. *Computers in Industry*, *115*. https://www.sciencedirect.com/science/article/pii/S0166361519304609?casa_token=VdFogPzDllgAAAAA:7_MNZIt-l3o1ZlAWp8_aISMnUTO_7GmOLC5AVI1d3tatFKL0q4xBAUTkwdi2lSper7cm6iuWCoaT

Tech's Importance in Communication—By Dave Ross. (n.d.). Retrieved May 16, 2023, from https://dave333.substack.com/p/techs-importance-in-communication

Thukral, D. (2019). Evolution smart world. *Infosys.Com*. https://www.infosys.com/services/engineering-services/white-paper/documents/evolution-smart-world.pdf

Tian, Z., Zhong, R. Y., Vatankhah Barenji, A., Wang, Y. T., Li, Z., & Rong, Y. (2021). A blockchain-based evaluation approach for customer delivery satisfaction in sustainable urban logistics. *International Journal of Production Research*, *59*(7), 2229–2249.

Tiwong, S., Ramingwong, S., & Tippayawong, K. Y. (2020). On LSP Lifecycle Model to Re-design Logistics Service: Case Studies of Thai LSPs. *Sustainability*, *12*(6), 2394. https://doi.org/10.3390/su12062394

Tripathi, S. P. (2020). Perspectives On Logistics Outsourcing. *JOURNAL OF CRITICAL REVIEWS*, *7*(15), 12.

Trueman, C. (2022, November 30). *IBM, Maersk scuttle blockchain-based TradeLens supply chain platform | Computerworld*. https://www.computerworld.com/article/3681098/ibm-maersk-scuttle-blockchain-based-tradelens-supply-chain-platform.html

Tsai, C., Ho, T., Lin, J., & Chang, C. (2021). *Model for Evaluating Outsourcing Logistics Companies in the COVID-19 Pandemic*. https://www.mdpi.com/2305-6290/5/3/64

Tsai, M.-C., Liao, C.-H., & Han, C. (2008). Risk perception on logistics outsourcing of retail chains: Model development and empirical verification in Taiwan. *Supply Chain Management*, *13*(6), 415–424. http://dx.doi.org/10.1108/13598540810905679

Vaismoradi, M., Jones, J., Turunen, H., & Snelgrove, S. (2016). Theme development in qualitative content analysis and thematic analysis. *Journal of Nursing Education and Practice*, *6*(5), p100. https://doi.org/10.5430/jnep.v6n5p100

Van de Ven, A. (2007). *Engaged Scholarship A Guide for Organizational and Social Research*. Oxford University Press.

Vandenabeele, S. (2014). Excess Baggage for Birds: Inappropriate Placement of Tags on Gannets Changes Flight Patterns | PLOS ONE. *PLOS ONE, 9*(3). https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0092657

Venkatesh, V., & Davis, F. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, *46*(2).

Venkatesh, V., Thong, J., & Xu, X. (2016). Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead. *Journal of the Association for Information Systems*, *17*(5), 328–376. https://doi.org/10.17705/1jais.00428

Venkatesh, V., thong, & Xin, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology on JSTOR. *MIS Quarterly*, *36*(1), 157–178.

Verma, P., Dixit, V., & Kushwaha, J. (2020). *Risk and Resilience Analysis for Industry 4.0 in Achieving the Goals of Smart Logistics: An Overview*. 7.

Vinogradova, N., Popova, T., Abdellah, C., & VAlentian Burenina. (2021). SMART technologies as the innovative way of development and the answer to challenges of modern time. *ITM Web of Conferences*, *35*. https://constellation.uqac.ca/id/eprint/7328/

Wagner, S. M., & Sutter, R. (2012). A qualitative investigation of innovation between third--party logistics providers and customers. *International Journal of Production Economics*, *140*(2), 944–958. https://doi.org/10.1016/j.ijpe.2012.07.018

Wang, Y., Man, R., Zhao, X., & Liu, H. (2020). Modeling of Parallel Movement for Deep-Lane Unit Load Autonomous Shuttle and Stacker Crane Warehousing Systems. *Processes*, *8*(1). https://www.mdpi.com/2227-9717/8/1/80

Weiland, A. (2021). Dancing the supply chain: Toward transformative supply chain managementError—Cookies Turned Off. *Journal of Supply Chain Management*, *57*(1), 58–73.

Zacharia, Z., Sanders, N., & Nix, N. (2011). The Emerging Role of the Third-Party Logistics Provider. *Journal of Business Logistics*, *32*(1), 40–54.

Zakharkina, L., Rubanov, P., Zakharkin, O., & Moldashbayeva, L. (2022). The impact of digital transformation in the accounting system of fuel and energy complex enterprises (International Experience). *International Journal of Energy Economics and Policy*, *12*(5), 152–161.

Zhang, G., Yang, G., & Yang, Y. (2022). Smart supply chain management in Industry 4.0: The review, research agenda and strategies in North America | SpringerLink. *Annals of Operations Research*, *322*(2), 1075–1117.

Zhang, X., & Bartol, K. M. (2010). LINKING EMPOWERING LEADERSHIP AND EMPLOYEE CREATIVITY: THE INFLUENCE OF PSYCHOLOGICAL EMPOWERMENT, INTRINSIC MOTIVATION, AND CREATIVE PROCESS ENGAGEMENT. *Academy of Management Journal*.

Žunić, E., Delalić, S., Hodžić, K., & Hindija, H. (2018, November). *Smart Warehouse Management System Concept with Implementation*. 14th Symposium on Neural Networks and Applications (NEUREL), Belgrade, Serbia. https://ieeexplore.ieee.org/abstract/document/8587004/

VITA

Raziel Bravo has 25 years of experience in diverse roles in the global Supply Chain Industry. She managed functions in Marketing, Sales & Account Management, Customer Solutions, Implementation, Sales Performance and Analysis, Sales Operations, Customer Service, Trade Lane and Route Development, Process Optimization, Product Management, and others. She joined GEODIS in 2010 following her tenure with other logistics providers, such as DHL Global Forwarding, and BAX Global, before its acquisition by DB Schenker and other logistics organizations of various sizes and services. her career.

She leveraged this experience in her current role as Senior Vice President of the Strategic Management Office, where her primary function is to develop initiatives based on changing market demands to meet organizational goals while managing the execution of these goals and other corporate ambitions and initiatives. Her vast employment history complements her goal to become a full-pledged academic practitioner, which is the goal of completing her doctorate degree. As a research practitioner, her first publication in the Journal of Theoretical and Applied eCommerce Research (https://www.mdpi.com/0718-1876/17/2/28) inspired her to establish a non-profit organization helping small businesses manage their supply chain.

She was born and raised in the Philippines, where she completed her undergraduate and earned a double major in Hospitality and Tourism Management, followed by her MBA, where she specialized in Marketing. After moving to the US permanently in 2007, she earned a Global Logistics Certification at California State University. She recently completed Certification in Strategy from Harvard Business School in 2022. She is a member of the

In her free time, she practices Yoga and Pilates, watches movies, and reads. Travel is a significant part of her activities for both work and leisure. It allows her to learn more about the supply chain industry and explore other cultures and to keep in contact with family and friends worldwide.

After completing her doctorate at Georgia State University, she aims to establish a non-profit organization supporting women empowerment in third world countries. She also would like to continue research in supply chain for academic and business publications, and eventually, venture in academia.