The Influence of Supply Chain Collaboration Strategies on Innovation Performance in the Pharmaceutical Industry: The Role of Supply Chain Competence and Absorptive Capacity on the Relationship

تأثير استراتيجيات التعاون في سلسلة الإمداد على الأداء الابتكاري في الصناعات الدوائية :دور كفاءة سلسلة الإمداد والقدرة الاستيعابية لامتصاص المعرفة على العلاقة

by

NOURA MOHAMED ALZAABI

A thesis submitted in fulfilment

of the requirements for the degree of

DOCTOR OF PHILOSPHY IN BUSINESS MANAGEMENT

at

The British University in Dubai

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Thesis Supervisor Professor

Stephen Wilkins

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Approved for award:

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Name Designation	Name Designation
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Abstract

Embedded under the theory of dynamic capabilities, this study aims to identify how the pharmaceutical industry can achieve innovation performance using supply chain collaboration strategies, and how this relationship is affected by factors such as supply chain competence and absorptive capacity. The present study is underpinned by the dynamic capabilities' theory as its primary guiding framework. Drawing on dynamic capabilities' theory, the researcher embedded the present research under a positivist paradigm and adopted a deductive approach.

In other words, the research was carried out using quantitative methodology whereby survey responses were collected from 351 pharmaceutical manufacturing industry members. Analysis of the data was carried out using Structured Equation Modelling (SEM) and revealed several key insights. The present research identifies that strategic relationship with supply chain partner is positively linked to innovation performance. In addition, supply chain competence mediates the relationship between supply chain collaboration strategies (strategic relationship with supply chain partner and supplier involvement in NPD) and innovation performance of the pharmaceutical manufacturing industry. It was also noted that supply chain competence was found to have a positive association with innovation performance. Furthermore, it was noted that the absorptive capacity does not impact the the relationship strength between supply chain collaboration strategies (strategic relationship with supply chain partner and supplier involvement in NPD) and innovation performance of the pharmaceutical manufacturing industry

The study has bridged an essential gap in the theoretical field of dynamic capabilities theory as only few studies have been conducted linking supply chain and dynamic capabilities. Secondly, the research generates essential knowledge by identifying the indirect link between supply chain collaboration strategies, supply chain competence and innovation performance. Furthermore, the research makes a novel contribution in the field of supply chain competence. The research enables managers in the pharmaceutical industry to obtain a deeper understanding of the advantages of adopting certain beneficial supply chain collaboration strategies to improve innovation performance, through supply chain competence.

الملخص

تهدف هذه الدراسة ، المُدمجة في إطار نظرية القدرات الديناميكية ، إلى تحديد كيف يمكن لصناعة الأدوية تحقيق أداء الابتكار باستخدام استراتيجيات التعاون في سلسلة الإمداد ، وكيف تتأثر هذه العلاقة بعوامل مثل كفاءة سلسلة الإمداد والقدرة الاستيعابية للشركة لاستقبال المعلومات، وترتكز هذه الدراسة على نظرية القدرات الديناميكية بوصفها إطارها التوجيهي الأساسي، واستناداً إلى نظرية القدرة الديناميكية، حيث قام الباحث بدمج البحث الحالي في إطار نموذج وضعي واعتمد نهجا استنتاجيا.

بعبارة أخرى، تم إجراء البحث على منهجية كمية تم بموجبها جمع الردود على الدراسة الاستقصائية من 351 شركه مصنعه للأدوية، وتم تحليل البيانات باستخدام نمذجة المعادلة الهيكلية والكشف عن عدة رؤى أساسية (أفكار أساسية). ويحدد هذا البحث أن العلاقات الاستراتيجية مع شركاء سلسلة الإمداد ترتبط ارتباطاً إيجابياً مع الأداء الابتكاري، وبالإضافة إلى ذلك تبين أيضاً أن كفاءة سلسلة الإمداد تتوسط العلاقة بين استراتيجيات التعاون في سلسلة الإمداد (العلاقة الاستراتيجية مع شريك سلسلة الإمداد ومشاركة المورد بهدف تطوير منتجات جديدة) والأداء الابتكاري في الصناعات الدوائية. كما لوحظ أن كفاءة سلسلة الإمداد ترتبط ارتباطاً إيجابياً مع الاداء الابتكاري. ايضاً، فقد تمت الملاحظة بأن القدرة الاستيعابية للشركة لاستقبال المعلومات لا تؤثر على قوة العلاقة بين استراتيجيات التعاون في سلسلة الإمداد (العلاقة الاستراتيجية مع شريك سلسلة الإمداد ومشاركة المورد بهدف تطوير منتجات جديدة) والأداء الابتكاري في الصناعات الدوائية.

استطاعت الدراسة معالجة فجوة أساسية في المجال النظري لنظرية القدرات الديناميكية حيث يوجد فقط دراسات قليلة تربط بين سلسلة الإمداد والقدرات الديناميكية. ثانياً، عمل البحث أيضًا على إيجاد المعرفة الأساسية عن طريق تحديد الصلة غير المباشرة بين استراتيجيات التعاون في سلسلة الإمداد، والأداء الابتكاري، وكفاءة سلسلة الامداد، بالإضافة الى ان البحث يقدم أيضاً مساهمة جديدة في مجال كفاءة سلسلة الإمداد، ويتيح البحث لمديري الصناعات الدوائية الحصول على فهم أكثر عمقاً لمزايا اعتماد استراتيجيات التعاون في سلسة الإمداد لتحسين الأداء الابتكاري من خلال رفع كفاءة سلسلة الإمداد.

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List of Abbreviations

AMOS	Analysis of Moment Structures
AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
EFA	Exploratory Factor Analyses
IFI	Incremental Fit Index
KMO	Kaiser-Meyer-Olkin
ML	Maximum Likelihood
NFI	Normed Fit Index
NPD	New Product Development
R&D	Research and Development
RFI	Relative Fit Index
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modelling
SV	Shared Variance
TLI	Tucker-Lewis Index
SPSS	Statistical Package for Social Sciences
VIF	Variance Inflation Factor

1 Chapter One: Introduction

This chapter discusses an overview of supply chain management, an overview of the pharmaceutical industry, and the pharmaceutical supply chain, and also offers an overview of its challenges. It analyses the aim, objectives, research questions, research problem, and study significance.

1.1 Overview of Supply Chain Management

According to Mentzer et al. (2001), a supply chain is “a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer” (p. 3). In another research study, Pedroso and Nakano (2009) argued that a supply chain is inclined toward information, material, and knowledge flow between stakeholders that adds value to all the parties involved. Due to the high level of competitiveness in the global market, corporations are integrating deeper supply chains (Choi & Linton 2011) and developing dynamic supply chains (Mena, Humphries & Choi 2013). Chen and Paulraj (2004) referred to the supply chain as the resources which help convey products to a buyer. Another definition of a supply chain is the link of both inbound and outbound products within value chain system (Miles & Snow 2007).

Chen and Paulraj (2004) asserted that a supply chain comprises of both indirect and direct stakeholders; it incorporates providers, distributers, producers, retailers, wholesalers, and different clients (Lambert, Cooper & Pagh 1998). Becker and Dietz (2004) noted that due to the increasing complexity of the technologies and knowledge processes, firms have had to extend their reach and obtain external knowledge. In this context, the idea of collaboration has gained traction as a reliable way to obtain new technology and knowledge from external sources. The benefits of leading such collaboration are vast: faster development of innovation, cost sharing, better economies of scale, risk spreading, and improved market conditions (Ahuja 2000).

Supply chain management is an amalgamation of business processes and stakeholders involved in producing and availing goods to end consumers (El Mokrini, Benabbou & Berrado 2018). As such, there must be a consideration for demand, display, and supply of the goods involved, making it vital to have an efficient strategy for marketing communication. There must be effective and reliable management and planning of activities which facilitate raw material sourcing, procurement, production, and optimization of logistics (El Mokrini et al. 2018).

The importance of the supply chain in the innovation process cannot be overlooked. Several studies have highlighted the importance of the supply chain in facilitating the innovation process by enabling collaboration (Ageron, Lavastre & Spalanzani 2013; Narasimhan & Narayanan 2013; Oke, Prajogo & Jayaram 2013). There are several ways in which supply chains can serve as the conduit for the innovation process and product development. For instance, sharing knowledge to allow firms to exist in a state of consistent learning and development through collaboration (Foss, Husted & Michailova 2010) is one way where a supply chain may be necessary. This study's research target is the pharmaceutical industry. The following sections delve into further detail in the context of the research.

1.2 Overview of the Pharmaceutical Industry

Shah (2004) defined the pharmaceutical industry as a combination of organisations, complete procedures, and operations that work together to design, develop and manufacture medicines or drugs. According to Bax and Green (2015), the pharmaceutical industry is a combination of firms which discovers, develops, produces, distributes, and markets pharmaceutical drugs/products.

The pharmaceutical industry is biotechnologically based. In recent years, biotechnology has triggered a globally significant improvement in individuals' health. The biotechnological progress in the pharmaceutical industry is due to the protection of intellectual properties of different key players in research and drug development (Weissman 2017). The pharmaceutical sector is entrusted with the task of undertaking research, formulation, manufacturing, and supply of drugs and medicines (Statista 2020a). The market has undergone substantial growth in the last 20 years, and in 2019, the revenues for pharmaceutical businesses around the globe reached USD 1.25 trillion (Statista 2020b). According to the forecasts similar to the one mentioned in Figure 1.1 below, from 2017 to 2030 the growth in the pharmaceutical industry around the globe is expected to compound by 160 percent with some of the largest predictions being made about India, which is anticipated to deliver a massive 232 per cent growth in the sector (Statista 2020c).

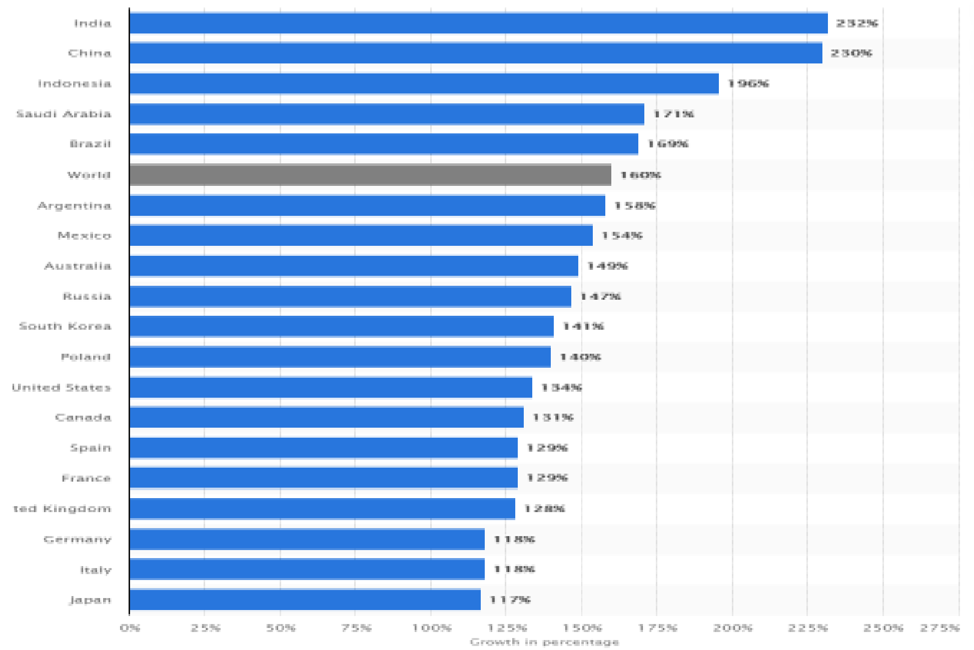


Figure 1.1: Worldwide forecast of pharmaceutical sector growth between 2017 and 2030 (Source: Statista 2020c)

In 2019, the expenditure on Research and Development (R&D) in the pharmaceutical sector was equivalent to USD 186 billion, internationally. To put this in context, in 2012, the overall spending on R&D was USD 136 billion (Statista 2020c). Firms operating within the pharmaceutical sector compared to other sectors have greater impetus to discover and formulate innovative products; therefore, they are much likely to invest substantial financial resources towards R&D (Statista 2020a). This is primarily because of the time-bounded patent protection extended to drugs and the foreboding risk of losing sales to competition by generic and biosimilar drugs (Statista 2020a).

There are two vital ways in which patent expirations impact the pharmaceutical industry: i) the intense focus on R&D; and ii) increased attention towards specialty drugs, both of which contribute towards the diversification of the product portfolio of a pharma enterprise (Statista 2020a). For the past few years, prominent advancements within the domain of pharmaceutical R&D have transformed the broader R&D arena as a whole. More and more manufacturing enterprises within the pharmaceutical sector are outsourcing vast portions of their R&D work, primarily to clinical research organisations that can be hired on contract to perform research on their behalf. The intent behind this is to alleviate costs. Another prominent development in the sector has been the use of big data in clinical research. The incorporation of big data has enabled predictive modelling that utilise clinical and molecular data to formulate safer and more effective drugs. Notably, real-time or real-world evidence (RWE) is garnering significant attention, making it essential for the pharmaceutical industry to cooperate and collaborate with tech firms to incorporate data from multiple different sources, including the data available on social networking platforms (Statista 2020a).

1.3 Pharmaceutical Supply Chain

The pharmaceutical supply chain (PSC) is a unique concept in the medical and business industry in which medications are manufactured, distributed, and subsequently used by the patient/consumer (Xie & Breen 2012). The pharmaceutical industry assumes a critical role in developing medications and immunizations to treat infections and illnesses as well as to improve healthcare all over the world. Papageorgiou (2009) explained that an organisation cannot compete without realising supply chain activities. Thus, the PSC incorporates numerous health regulatory authorities, research organisations, medical clinics, government units, drug manufacturers, hospitals, clinics, and pharmacies.

Pedroso and Nakano (2009) stated that the primary area of concern in PSC is the management of knowledge, which can be used to fuel product development phases. The authors noted that this area should require more focus in a PSC as the R&D process is distinct and highly time intensive in this sector. The supply chain process in the pharmaceuticals industry is portrayed by long-term handling times and the operating of multiple procedures. Therefore, the management of PSC has become increasingly perplexing in view of the fact that it includes life-and-death situations for individuals and requires the interest of various partners; for example, pharmacies, hospitals, wholesalers, merchants, clients, research organisations, and drug manufacturers. Pharmaceutical organisations as players of the medication supply chain can face numerous challenges (Pedroso & Nakano 2009).

The PSC is the incorporation of essential business processes across a supply chain to generate value for end users and stakeholders. After drugs have been launched, the pharmaceutical industry sets different objectives and drivers to enable it to distribute the end product to the users. The PSC incorporates various government agencies, healthcare facilities, manufacturers, suppliers, retailers, and research departments (Ding 2018). Moreover, the PSC is responsible for the distribution of various drugs which have different operational objectives and handling needs (Ding 2018).

According to Northrup (2005), pharmaceutical firms are characterized by higher R&D spending, greater acquisition of intellectual capital, and targeted marketing towards healthcare professionals. In addition, Northrup (2005) remarked that the production process of pharmaceuticals is unique due to the intense regulation that is maintained both by the company itself, the rules and regulations of the country in which it operates, and the rules of the medical community. In addition, Zhong et al. (2016) stated that the PSC involves drug R&D, manufacturing, and distribution of pharmaceutical products across various healthcare services and pharmaceutical businesses, which improves the effective functioning at these stages. PSC involves markets, intermediaries, processes, and products. Moreover, the pharmaceutical industry has control of drug distribution to optimize the possibility of different distribution channels and to protect patients from product defects which might occur during repackaging and relabelling of pharmaceutical products.

In light of this complexity, Gupta, Pawar and Smart (2007) identified three distinct phases in the product development of a pharmaceutical firm: drug discovery, development—which consists of preclinical development, clinical trials, and regulatory approvals—and the final stage - product commercialization. In addition to having an entirely different R&D process in comparison to other industries, the pharmaceutical industry also has a different supply chain structure, starting from new product development through to the delivery of the product to the patient. This supply chain structure is shown below in Figure 1.2.

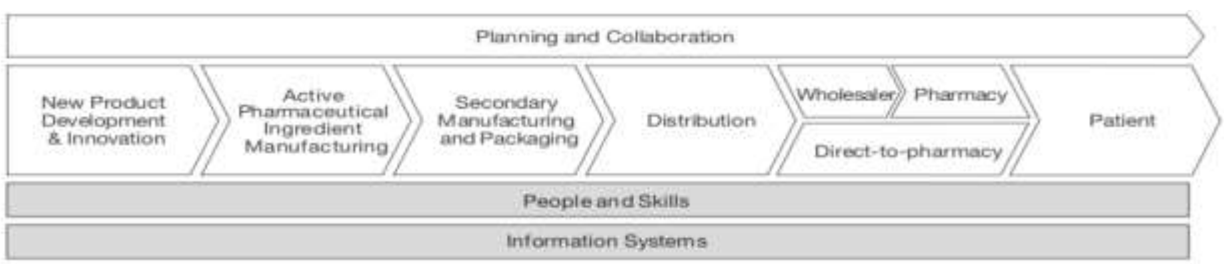


Figure 1.2: PSC structure (Adapted from Friend, Swanick & Arlington 2011)

PSC entails a sequential structure through which drugs are delivered from the pharmaceutical industry to the end users; that is, the patients (Viegas et al. 2019). Pharmaceutical products are distributed from pharmaceutical producers to wholesale suppliers. The wholesale supplier processes the drugs through quality and utilization management screening. After this process, the wholesale supplier distributes the pharmaceutical products to the doctors and pharmacies where the products are then prescribed to the end user/patient (Datex Corporation 2019). Nevertheless, there are variations in the PSC due to constant involvement of key players in research departments and the process of developing pharmaceutical drugs.

The pharmaceutical supply chain is different compared to that in other industries as it involves the development and innovation of new products, manufacturing of active pharmaceutical ingredients, and a secondary manufacturing process that also involves packaging, distribution to wholesalers who supply the pharmacies or directly to the pharmacies, and then to the final consumer who is the patient. The pharmaceutical supply chain involves efficient information systems to manage the flow of the products, data, information, and financial resources throughout the supply chain (Friend, Swanick & Arlington 2011).

New Product Development and Innovation: The initial step is the innovation and development of a new product. This step is guided by the existence of a gap in the market. Through innovative means, the manufacturers can develop a product that caters to the patients' needs and helps in revenue creation. Planning is needed to determine the whole process of manufacturing and distribution of the product to the people. Therefore, various departments in the organisation gather their resources, which involves multiple people with multiple different skills and resources (Friend, Swanick & Arlington 2011).

Active Pharmaceutical Ingredient Manufacturing: The active ingredients that are the core components of the products are developed. This process involves introducing the main feature of the drug that is medically beneficial to the patients. After this step, the drug is effective but needs packaging and branding (Friend, Swanick & Arlington 2011)

Secondary Manufacturing and Packaging: Secondary manufacturing, packaging, and branding. This step is aimed at adding value to the product that has been manufactured. The manufactured drug is put in appropriate branded packages for easier handling. The branding helps in displaying product and marketing it to potential clients (Friend, Swanick & Arlington 2011).

Distribution: The manufacturers are then involved in managing the actual distribution of medications from their warehouses to pharmaceutical wholesalers or directly to retail pharmacy chains, specialty pharmacies, mail ordering pharmacies, healthcare facility chains, and health centres. Pharmaceutical developers have significant influence over the prices, assessing the expected consumer demands, projecting the future competitions, and estimating marketing expenses to establish the wholesale acquisition cost (WAC; Friend, Swanick & Arlington 2011). The next step in the pharmaceutical product supply chain involves wholesale distributors who buy these products from the manufacturer and distribute them to an assortment of clients who include pharmacies. The distribution step serves as the information link between manufacturers, wholesale distributors, and the PBM. A pharmacy can purchase a pharmaceutical product directly from the manufacturer or through the wholesaler (Friend, Swanick & Arlington 2011).

Patients: Pharmacies are considered the last step for pharmaceutical products before they get to the patients, which is also a vital link in the supply chain. After buying the products, the pharmacy needs to maintain a sufficient stock of the product and offer efficient information to the patients regarding the safety and effectiveness of the prescribed medication as well as medication utilization. Patients are then able to access these products for use in treatment and disease-prevention processes (Friend, Swanick & Arlington 2011).

1.4 Challenges within the Pharmaceutical Supply Chain

The pharmaceutical industry operates in a highly competitive environment with the possibility of changing rules and the need for consistent research (Nozari & Szmelter 2018). The pharmaceutical supply chain has faced several challenges which hinder the attainment of organisational goals of efficiency, profit-making, and accountability. There are many challenges surrounding the PSC process. According to Privett and Gonsalvez (2014), some challenges include temperature control, inventory optimization, product damage, lack of coordination, human resource dependency, production time, shipment visibility, as well as R&D.

Temperature control: Certain pharmaceutical products are stored and transported in a controlled temperature. Many pharmaceutical products are temperature-sensitive; therefore, they are kept and then distributed in temperature-controlled environments as they move across the PSC. Failure to maintain the correct temperature during manufacturing and development, shipment and supply, and storage will lead to the untimely delivery of spoilt drugs which cannot then be given to customers (Sykes 2018). Additionally, when these products are distributed from the manufacturers to the consumer, the temperature may vary, thus lowering product quality and usability. Available temperature-controlling technologies have not been fully used; therefore, temperature control remains a pharmaceutical supply chain challenge (Sykes 2018). According to the WHO (2005), uncontrolled temperatures leaving the pharmaceutical products exposed to freezing or hot temperatures is considered a major cause of wastage. Temperature failure can reduce the efficacy as such wastage results in high risk to patients through lack of medication and large financial loss. A cold supply chain uses ice and dry ice to transport products, which causes the products to freeze when not packed appropriately and also to be exposure to higher temperatures when shipment delays occur which cause ice to be melt (Privett & Gonsalvez 2014).

Inventory optimisation: Inventory management in pharmaceutical supply chains is a challenging and complex task, specifically considering the lack of information. Inventory optimisation entails decisions related to capacity, replenishment orders, quantification and the management of different inventory levels. Firms typically utilize precise information to make such decisions. However, there is still some unavoidable uncertainty that can affect inventory optimisation (Privett & Gonsalvez 2014).

In addition to the inventory management challenge is the pharmaceutical products' failure to meet high market demands. The greatest challenge facing the PSC is ensuring that the supply and distribution of pharmacological products meet the rising demand of healthcare organisations. Absent and/or aggregated demand information creates serious issues in management and procurement decisions (Privett & Gonsalvez 2014).

Another part of inventory optimisation is expiration, which is considered a major source of product wastage (World Health Organization 1999). According to Privett and Gonsalvez (2014), there are many different factors which can have an effect on expiration including selection of medication, prediction, procurement, demand, consumption, employee training, inventory management, and warehouse management. Improper management, particularly in the areas of procurement, ordering, forecasting, and quantification can lead to oversupply, that is, the supply of a larger quantity of products than is possible for the firm to consume before their expiration dates. The situation can be exacerbated by delays in shipment which can shorten the shelf life of products. Lack of warehouse management and employee training can also lead to expiration, as a result of poor compliance with the First-Expired-First-Out inventory policy (Privett & Gonsalvez 2014).

Product damage: Pharmaceutical products are considered to be harmful if they are damaged without being tested for contamination. Pharmaceutical products require more attention than any other product because they are used to manage or restore health. For instance, a damaged package is discarded even if its contents are safe because there are no criteria to determine whether the material in the box is contaminated or not (Sykes 2018). The dangers associated with damaged pharmaceutical products due to damage or contamination are severe to a certain extent. Product damage can occur during the packaging process or when stored in a warehouse; therefore, warehouse employees should be cautious while repackaging and handling these products. Additionally, pharmaceuticals are exposed to damage when they are transported (Sykes 2018). The logistics department must thus focus on product safety and ensure that the packaging requirements have been followed. A single mistake can result in ruining whole consignment, resulting in a massive loss of profit (Qudrat-Ullah 2018). Pharmaceuticals require a highly sanitized environment, free from moisture (Sbai & Berrado 2018). The requirement is meant to protect patients from harm so some of the medications are stored in glass bottles. Pharmaceuticals have a high potential for damage during transit (Qudrat-Ullah 2018).

Lack of coordination: Lack of coordination is a significant challenge in the global pharmaceutical industry. There are numerous connections in the PSC which require that supply chains should be adaptable, effective, resilient, and coordinated (Gereffi 2017). Coordination between supply chain parties has many benefits, such as avoiding a duplication of effort, ensuring comprehensive implementation, increasing optimal use of resources, and improving supply chain performance.

However, some supply chain parties face difficulties in implementing this level of coordination as not all supply chain parties have identical priorities (Yadav 2010).

Shipment visibility: Prescription drugs must not be distributed incorrectly or have incorrect labelling, as this issue will affect the manufacturers' reputation and harm patients (Forghani et al. 2018). Having an ineffective distribution network can also result in legal disputes and disrupt the process of patient healing and medical administration (Forghani et al. 2018).

Human resource dependency: The PSC depends on human resources for research and drug development, manufacturing, and distribution. Since pharmaceutical products have high value and are hugely profitable, which results in greater chances of theft. This, these products may end up in wrong hands (Gereffi 2017). Once these products are in the wrong hands, they may be used for the unintended purpose of causing harm to the users. Most pharmaceutical industry members face this challenge and are trying to find out the best way to shift from human labour to automated storage and retrieval systems (Gereffi 2017).

The majority of supply chain logistics depend on human resource supervision, including human-operated pallet jacks and forklifts (Papalexi et al. 2020). The available product delivery platforms must be secured to enhance efficiency and accountability. Notably, counterfeit products can be smuggled into the supply chain, thus posing a challenge on the need to increase security during shipment (Papalexi et al. 2020). Some pharmaceuticals can pose health challenges that make it necessary for the management to consider automation. Even so, this issue poses a challenge as the transit will still involve human intervention where drivers and security are concerned (Privett & Gonsalvez 2014).

Production time: This is considered to be a significant expense in both time and cost when performing clinical trials which often have extremely low rates of success in the discovery of new products and clinical development. There has been competition from the generic forms of the drugs after the end of the patent life, which has made demands and capacity planning very unpredictable and uncertain (Khayyal 2015). The industry has been growing considerably, and this is also one of its challenges (Rossetti, Handfield & Dooley 2011).

Research and development productivity: Northrup (2005) stated that developing pharmaceutical products carries high-risk and high-sunk costs, as well as long payback times. To put this in perspective, Pedroso and Nakano (2009) noted that out of the heavy investment put into R&D, only two to three percent of the products are commercialized and new product development can take as long as 15 years from conception to commercialization. The authors additionally note that in order to pay for the R&D process, pharmaceutical firms have to apply for patents in the beginning of the R&D process. Due to high competition, a very short period of time is usually given to pharmaceutical firms to establish prices which enable the R&D process.

Based on market dynamics, which are influenced by a potential change of law, new diseases, and prescription drug resistance, it remains necessary for manufacturers to respond through research and product development (Shah 2004). Manufacturers need to decide on effective drug development management, as they feature researchers from various fields of competencies to advance the realisation of customers' needs. Ultimately, some drugs have exited the market after years of useful service (Shah 2004). Diseases take new forms and become resistant to some medications, which force manufacturers to advance their efforts on research and extension. There is a need to understand the applicable manufacturing patterns and the importance of implementing every set of systems through process development (Shah 2004). The quality of production is enhanced commensurately with the gathered marketing research across the supply chain.

The supply chain systems for prescription drugs may face some challenges that demand immediate strategic decision making (Shah 2004). For instance, market dynamics can result in high competition, the possibility of new drug acceptance in the market, and change of law. Some medications may be rendered ineffective and thus not for sale in particular countries, meaning that the manufacturing firms have to change their focus to gain a specific market (Shah 2004).

One of the critical strategic issues in supply chain management for pharmaceuticals is new product development and management capabilities (Sylim et al. 2018). The primary problems affecting this variable include a short product life cycle and rapidly advanced technologies. Such factors increase production costs, an issue that must be curbed to provide consumer-friendly prices to the end consumer (Sylim et al. 2018).

Strategic issues such as allocating significant resources to R&D while either exclusivity or the life span of new products cannot last for a prolonged period remain a concern (Silva & Mattos 2019). Unlike other industries such as oil and gas where a product can be produced and serve the market for decades, most pharmaceuticals have a short life-span due to the change of laws, inefficiency, introduction of new diseases, scientific advancements and the spread of some new, drug-resistant infections. New healthcare needs should be met through consistent R&D, and also sufficient supplementing of the PSC with the correct medication. The significant benefit that certain firms possess is the possibility of having tax credits in some countries and retaining a reliable and trustworthy supply chain. Otherwise, the industry may not be lucrative enough, resulting in start-up firms pulling out of the market (Silva & Mattos 2019).

1.5 Challenges within the Pharmaceutical Supply Chain during the COVID-19 Pandemic

Since early 2020, the world has been struggling to contain and mitigate the novel COVID-19 virus, which has created immense uncertainty and massive disruption in the global supply chain and inventory management. The worldwide supply chain is undergoing tremendous challenges in managing the smooth distribution of products such as food, medical equipment, as well as masks and medicine needed for the treatment, protection, and the ultimate mitigation of the pandemic (WHO 2020). As if the virus's adverse effects were not enough to disrupt the flow and exchange of essential goods and required services, the measures taken by individual countries are even worse as these have limited the flow of goods from manufacturing countries like China (WHO 2020).

The blockage of people and movement of products has disrupted every supply chain and caused a global shortage of essential and personal equipment needed to combat this pandemic. This blockage poses a considerable challenge to keeping the global supply chain of essential goods operating when some crucial aspects of the supply chain have been halted due to containment measures (Hobbs 2020). The effects and the challenges of the virus, coupled with the containment measures that caused unforeseen challenges for various institutions' stockpiles, have caused inventory challenges with the increasing demand and immediate need for essential medical supplies (Hobbs 2020).

The instituted lockdowns put in place to mitigate the pandemic's effects have caused an increase in the demand for certain products. It has also become difficult to forecast and predict consumers' demand patterns, hence posing a challenge to inventory management and facilitating shortages caused by this lack of crucial information (Hobbs 2020). The pandemic led to a low supply of pharmaceuticals required to mitigate the spread of the disease, offer support, or moderate infection symptoms. The shortage of these drugs was due to unexpected demand, the demand surpassed the manufacturing capacity of most pharmaceutical firms in all over the world (Socal, Sharfstein & Greene 2020 p.1349).

The outbreak of COVID-19 increased the demand for critical drugs, which depleted the inventories of pharmaceuticals and raw materials (Socal et al. 2020). The pharmaceutical manufacturing firms project the capacity to produce based on the known market requirements. The disease outbreak took a long time, which manufacturers did not expect. Additionally, most countries imports Active Pharmaceutical Ingredients (APIs) from China, Europe, and India (Socal et al. 2020). China consider as the primary source of APIs for essential drugs such as antivirals and antibiotics, was hard hit by the pandemic. The manufacturing companies closed down, affecting production. Some companies have resumed production, but the government has imposed lockdowns and social distancing, which has reduced labor in these companies. The supply of anesthesia products such as Propofol for maintaining ventilation of COVID-19 patients, was affected by such delays (Haleem, Javaid & Vaishya 2020). The production of active ingredients slowed down because of the lockdowns and closure of factories. The underproduction has led to increased production costs (Tirivangani et al. 2021, p.3). Additionally, Foreign inspection, production, and transportation of the APIs were also delayed. Countries like India stopped shipping drugs to other countries as it gave priority to their citizens (Chatterjee, 2020, p.676). Domestically, the travel ban slowed down the FDA oversight of drug production. Inspection of drug manufacturing plants in China (Socal, Sharfstein, and Greene, 2020, p.1351)

Therefore, there is need to better understand the need for effective logistic operations and inventory management for pandemic or epidemic control (Dasaklis et al. 2012; Hobbs 2020) to mitigate these effects via collaboration. Various manufacturing and production firms are collaborating with several suppliers, government departments, health organisations, and community-based organisations to help fight the pandemic and address the challenges emerging.

Sanofi and GlaxoSmithKline (GSK) collaborate to develop a vaccine targeting the original *D.614 virus* and the *B.351 variant* in varied regions. In the third phase, the two companies have started clinical studies to assess the adjuvanted recombinant-protein COVID-19 vaccine candidate (Sanofi, 2021e). The research shall target more than 35,000 adults volunteers. The Vaccine from this study will prevent symptomatic COVID-19 SARS-Cov-2 in adults, preventing symptomatic infection (Sanofi, 2021b). The companies are also planning to commence studies to establish the ability of the adjuvanted recombinant-protein Vaccine to provide a strong booster response after the initial jab (Sanofi, 2021b).

GSK and Sanofi have partnered to produce vaccines in large quantities for distribution worldwide. Sanofi gives a *recombinant antigen,* while GSK provides the pandemic adjuvant, and when combined with the pandemic adjuvant, recombinant technology produces a vaccine that can withstand temperatures during routine vaccination (Sanofi, 2021e). The distribution and storage of these vaccines across the globe can minimize the supply interruptions along the supply chain because it keeps at the standard refrigeration. Also, the distribution of the vaccines is possible through the existing infrastructure (Sanofi, 2021b). Sanofi is developing a messenger RNA vaccine with Translate Bio, apart from the recombinant protein-based Vaccine. Consequently, Sanofi has acquired Translate Bio to hasten the development of therapies and vaccines using *mRNA technology* (Sanofi, 2021b)

It also becomes vital for companies and government agencies to invest in an inventory management system to facilitate information flow among different entities in order to address demand and facilitate the supply and distribution of required products (van der Laan et al. 2016). In responding to these emerging issues and the unprecedented disruption caused by this pandemic, entities in various sectors such as pharmaceutical firms play a crucial role in inventing new ways of doing business and managing stockpiles (Hobbs 2020). During this time, the world has experienced significant innovations in business approaches and the use of technologies to facilitate inventory handling and management.

Sanofi is also partnering with pharmaceutical manufacturing companies in various countries to produce enough quantities to control the pandemic (Sanofi, 2021a). The supply chain and distribution of medicines are critical for Sanofi to fulfill its public health mission. The company is committed to delivering medicines and vaccines worldwide with minimum interruption (Sanofi, 2021c). The company has an agreement with BioNTech and Johnson &Johnson to utilize their production infrastructure. It also supports the manufacturing and supply of BioNTech Covid-19 vaccine developed in partnership with Pfizer and Johnson & Johnson (Sanofi, 2021d).

In unprecedented circumstances like the current pandemic where an unexpected situation causes stock demand to fluctuate, an effective and efficient inventory management system can prove beneficial. An effective system can help reduce the required workforce needed to handle excess stock, help prioritise and distribute products effectively, hence addressing shortages, reducing wastage of resources, and anticipating what is needed and how much can be handled at a certain period (Dasaklis et al. 2012). Such a system can help automate many aspects of inventory and ease operations, while also delivering visibility and helping to monitor price trends, while also facilitating proper procurement deals (van der Laan et al. 2016). It has become evident that innovation is crucial in addressing shortage in inventory in managing demand caused by unprecedented circumstances such as a pandemic. It is therefore essential to make needed adjustments in disaster relief management (Gupta et al. 2016). Risk management and effective inventory management systems need to be prepared for future pandemics so crucial stakeholders can face the challenges with proper means and methods (Hohenstein et al. 2015).

1.6 Research Problem

Managing the supply chain of the pharmaceutical industry is of critical importance due to the nature of the industry and the rapid R&D change taking place in the industry. In the pharmaceutical industry, the supply chain needs effective management in the links between the laboratory and the marketplace (Friend, Swanick & Arlington 2011). Due to continuous shifts taking place in the market, changes in the products have rendered the manufacturing and distribution processes highly complex whereby the nature of the product changes the nature of the supply chain (Friend, Swanick & Arlington 2011).

Furthermore, it is crucial for pharmaceutical firms to develop supply chain-related dynamic capabilities to fully leverage their supply chain capabilities and enhance its innovation performance (Alinaghian, Kim & Srai 2020). Due to the rapidly changing nature of the pharmaceutical industry, the sector's supply chain actors need to be able to sense, seize, and reconfigure their internal and external asset positions by engaging in knowledge sharing (Ambrosini & Bowman 2009; Teece 2007). This will lead to pharmaceutical firms generating a high degree of inimitable and non-substitutable resources which can substantially enhance the competitiveness and the performance of the supply chain (Zheng, Zhang & Du 2011). This becomes more important during times of crisis such as the global COVID-19 pandemic that has pushed the boundaries of the healthcare and pharmaceutical sectors across the world.

During a pandemic, while treatment of viral symptoms is necessary, several pharmaceutical firms engaged in extensive R&D to develop a cure, in the form of a vaccine. Furthermore, when countries shut down their borders to curb the spread of the virus, the largest impact of that is seen on the supply chain of large corporations. Firms, such as those in the pharmaceutical industry, have international supply chains which experience the threat of disruption and badly affected performance. Therefore, the need to enhance innovation performance is greater now more than ever to ensure that the pharmaceutical industry has a fully functional and high-performing supply chain that is focused on enhancing the rate of R&D that it needs to develop innovative solutions for the health of the general population.

Although the subject on supply chain and innovation performance has received many scholars' attention (e.g. Gao et al. 2017; Iddris 2016; Munksgaard et al. 2014; Sabri et al. 2018; Tan et al. 2015; Hui et al. 2015, Yoon et al. 2016) there is a gap of in-depth empirical studies about the use of different supply chain collaboration strategies to improve innovation in supply chain context (Zimmermann, Ferreira & Moreira 2016). Additionally, this knowledge gap gets wider in the context of pharmaceutical industry (Aghmiuni et al. 2020; Kim et al. 2021). The gap in the literature shows that there is a need to understand how different supply chain collaboration strategies could differently impact innovation performance, moreover, to identify what is the appropriate strategy to be applied to enhance innovation performance (Zimmermann et al. 2016).

Numerous studies have examined the role of supply chain partnerships in boosting its innovation performance (Ageron et al. 2013; Golgeci & Ponomarov 2013; Narasimhan & Narayanan 2013; Oke et al. 2013; Roy, Sivakumar & Wilkinson 2004). The primary intention behind firm collaborating with other firms is to gain access to useful resources that are otherwise not available within the firm (Rese et al. 2013). This is because more often than not, firms lack the resources or the capabilities that are required to develop the components of the products they finally sell (Yeniyurt, Henke & Cavusgil 2013). Firms that collaborate with external teams have been reported to be more innovative than firms that depend entirely on internal knowledge and resources (Fitjar & Rodriguez-Pose 2013). Thus, if firms share knowledge and collaborate with their supply chain partners, they are more likely to gain a competitive advantage (Saenz et al. 2014). Moreover, collaboration with suppliers not only affects innovation in firm; rather, it determines to a large extent whether there will be innovation at all (Roy et al. 2004).

Various studies have discussed the factors that influence innovation performance, but there is still a vast scope in the area that is yet to be covered in research (Ageron et al. 2013; Golgeci & Ponomarov 2013; Narasimhan & Narayanan 2013; Oke et al. 2013; Rajapathirana & Hui, 2018; Roy, Sivakumar & Wilkinson 2004; Zhang et al. 2019). One of the antecedents of innovation performance is strategic relationship with supply chain partner. Developing strategic relationship with supply chain partner is one of the most crucial ways of facilitating reconfiguration of resources, increasing innovation, enhancing the extent of knowledge absorption, and improving the overall performance of the firm (Battor & Battor 2010; Ritter & Gemünden 2003; Tzokas et al. 2015). In addition, strategic relationship with supply chain partner can generate a myriad number of benefits for firms. This capability of the firm to engage in forming strategic relationship with supply chain partner is considered to be a higher-order dynamic capability (Kohtamäki, Rabetino & Möller 2018). This is due to the development of strategic relationship which lead to the development of strategic partnerships, and coordination with value partners, which is then a necessary condition for innovation and firm performance (Hagedoorn 1993; Hamel 1991; Inkpen 2000; Inkpen & Dinur 1998; Yang et al. 2015). Furthermore, due to the fact that organisational learning occurs during strategic relationship, it serves as a way for firms to accumulate external knowledge through various strategic relationship, thereby ensuring development through knowledge sharing (Yang et al. 2015; Niesten & Jolink 2015). However, there is limited research exploring the formation of strategic relationship with supply chain partner in the pharmaceutical industry and its effect on innovation performance. It is important to examine this relationship to ensure that appropriate strategic relationship with supply chain partner is developed which can enhance innovation performance of the pharmaceutical industry.

In addition to strategic relationship with supply partner, supplier involvement in NPD has also been identified as an antecedent of innovation performance (Zimmermann et al. 2016). Supplier involvement in NPD has been shown to influence the competitive advantage of a firm as well as provide myriad positive benefits to that firm (Gonzalez-Zapatero, Gonzalez-Benito & Lannelongue

2016; Mu, Tang & MacLachlan 2017; Nagashima et al. 2015; Scholten & Schilder 2015). The importance of supplier involvement across the supply chain is a critical element of the integration for the new product development process. Based on the views of Salvador and Villena (2013), the principal motive for this integration is the reduction of costs and the dispersion of risk in the case of failure. Additionally, Pero et al. (2010) have stated that there is a lesser chance of failure when work is being done in an integrated network as it reduces the disruption of supply. Furthermore, when suppliers are involved into the NPD process, firms are able to sense new opportunities, seize them, and reconfigure their internal assets in order to develop a new product, thereby rendering supplier involvement in NPD a higher-order dynamic capability. However, while the importance and effect of supplier involvement in NPD has been understood, there is paucity of research examining the role of supplier involvement in NPD as a higher-order dynamic capability and its resultant influence on innovation performance. This gap is even wider in the research focusing on the pharmaceutical industry (Aghmiuni et al. 2020; Kim et al. 2021).

The existing literatures on the relationship between supply chain collaboration strategies and innovation performance has largely used resource-based view theory and knowledge-based view theory (e.g. Fawcett, Jones & Fawcett. 2012; Lefebvre et al. 2014; Liao & Kuo 2014; Singh & Power 2014; Tan & Ndubisi 2014) as their theoretical base. However, only few studies used dynamic capability theory (e.g. Golgeci & Ponomarov 2013; Saenz, Revilla & Knoppen 2014). Until now, only few researchers have used dynamic capabilities in a context of supply chain management (Masteika & Čepinskis 2015). Additionally, an unexplored issue remains about how dynamic capabilities can reinforce and allow pharmaceutical firms to enhance innovation performance.

The link between supply chain collaboration strategies, supply chain competence, and innovation performance has not been studied extensively from the perspective of the pharmaceutical industry. Previous studies have explored the innovation process because innovation is considered as a crucial factor to sustain a competitive advantage (Damanpour 1989; Dougherty & Hardy 1996; Maidque 1980; Zirger & Maidique 1990). Though there are many innovation models available in literature, to the best of the researcher's knowledge, there are no studies which have evaluated the relationship between supply chain collaboration strategies, supply chain competence, and innovation performance. Most published studies have only assessed the impact of competencies on the competitive advantage or overall performance of a firm. (Amit & Schoemaker 1993; Barney 1991; Hafeez, Zhang & Malak 2002; Hitt & Ireland 1983; Peteraf 1993; Rumelt 1991; Wernerfelt 1984). Literatures need to measure the influence of supply chain competence on innovation performance. While innovation performance and supply chain competence are complicated topics and categorised by a lower degree of comprehension, there is a need for more empirical examinations especially in the context of pharmaceutical industry, so that managers employed in the pharmaceutical industry can more easily grasp and apply these concepts. Moreover, the mediation role of supply chain competence as collective learning needs be investigated for the relationship between supply chain collaboration strategies and innovation performance, as such variables have not been widely investigated in previous studies. The mediation role of supply chain competence could help to understand how dynamic capabilities lead to innovation performance, as recognized by previous literature that it is not well understood how dynamic capabilities could affect performance (Eisenhardt & Martin 2000; Pavlou & El Sawy 2011; Zott 2003).

In addition to the above, the role of absorptive capacity also needs to be considered. The present study is evaluating absorptive capacity, which is a form of dynamic capabilities that has the potential to influence the relationship between supply chain collaboration strategies and innovation performance. Absorptive capacity is the capability with which a firm is able to recognize new information, process it, and apply it to reconfigure its asset base (Cohen & Levinthal 1990). Absorptive capacity involves the codification of knowledge as well as the reconfiguration of its own assets to react to the knowledge obtained, which is a time-consuming process (Senivongse, Bennet & Mariano 2019). Therefore, due to the effects of time, Senivongse, Bennet, and Mariano (2019) summarised that it is not possible for absorptive capacity to have a direct influence on any parameter of the firm whereby only an indirect relationship is possible. Even though various studies have established the importance of absorptive capacity in improving firm's innovation performance, both in the general context of supply chains (Harris et al. 2020; Zhu, Zhao & Abbas 2020; Zou et al. 2018) and the specific context of pharmaceuticals (Fernald 2017), current literature fails to offer conclusive results in this area. Moreover, the literature that discusses the moderating role of absorptive capacity in relation to innovation performance and supply chain collaboration strategies is still sparse.

Finally, while various studies have discussed the many factors that determine and/or effect of innovation performance, none of these studies have combined strategic relationship with supply chain partner, supplier involvement in NPD, absorptive capacity, supply chain competence, and innovation performance, this relationship has not been explored in past research. With this gap being more prominent in the pharmaceutical industry (Aghmiuni et al. 2020; Kim et al. 2021), there is a need and importance to conduct this study as innovation and supply chain competence are core factors of research. The lack of studies that connect supply chain collaboration strategies and innovation performance through absorptive capacity and supply chain competence necessitates a study such as the present one to bridge this research gap.

1.7 Aim and Objectives

Embedded under the theory of dynamic capabilities, this study aims to identify how the pharmaceutical industry can achieve innovation performance using supply chain collaboration strategies, and how this relationship is affected by factors such as supply chain competence and absorptive capacity, as shown in Table 1.1 below.

Table 1.1: Constructs in the proposed conceptual model

Independent Variables	**Mediator**	**Moderator**	**Dependent Variable**
Strategic Relationship Supplier Involvement in NPD	Supply Chain Competence	Absorptive Capacity	Innovation Performance

The objectives of the study are as follows:

1. To investigate the role that strategic relationship with supply chain partner plays in facilitating the improvement of innovation performance.

2. To investigate the role that supplier involvement in NPD plays in facilitating the improvement of innovation performance.

3. To identify the mediating role of supply chain competence in the relationship between strategic relationship with supply chain partner and innovation performance.

4. To identify the mediating role of supply chain competence in the relationship between supplier involvement in NPD and innovation performance.
5. To illustrate how absorptive capacity moderates the relationship between strategic relationship with supply chain partner and innovation performance.
6. To illustrate how absorptive capacity moderates the relationship between supplier involvement in NPD and innovation performance.

1.8 Research Questions

This research study aims to answer the following questions:

- **RQ_1**: To what extent does strategic relationship with supply chain partner influence a pharmaceutical manufacturer's innovation performance?
- **RQ_2**: To what extent does supplier involvement in NPD influence a pharmaceutical manufacturer's innovation performance?
- **RQ_3**: To what extent does supply chain competence mediate the relationship between supplier involvement in NPD and innovation performance in the pharmaceutical manufacturing industry?
- **RQ_4**: To what extent does supply chain competence mediate the relationship between strategic relationship with supply chain partner and innovation performance in a pharmaceutical manufacturing industry?

- **RQ_5**: To what extent does absorptive capacity moderate the relationship between strategic relationship with supply chain partner and innovation performance in a pharmaceutical manufacturing industry?

- **RQ_6**: To what extent does absorptive capacity moderate the relationship between supplier involvement in NPD and innovation performance in a pharmaceutical manufacturing industry?

1.9 Significance of the Study

One of the primary gaps identified was that research into the relationship of supply chain collaboration strategies (strategic relationship with supply chain partner and supplier involvement in NPD), and innovation performance has not yet been explored empirically in past research in the context of pharmaceutical industry. Furthermore, an additional gap was that the potential interaction effect of absorptive capacity has also not been studied in the context of supply chain collaboration strategies and innovation performance. With this gap being more prominent in the pharmaceutical industry, the present study aims to identify how the pharmaceutical manufacturing industry can achieve innovation performance using strategic relationship with supply chain partner and supplier involvement in NPD, and how this relationship is affected by factors such as supply chain competence and absorptive capacity.

The present study is significant from two perspectives. Firstly, the results of this study are expected to be consider as a base of the future studies relating supply chain collaboration strategies, supply chain competence to innovation performance. The role of supply chain competence on the relationship between supply chain collaboration strategies and innovation performance has not been studied previously. Moreover, this work will contribute to the studies that examined the moderating effect of absorptive capacity as a dynamic capability. Using the dynamic capability theory will provide an insight into how supply chain collaboration strategies as a dynamic capability influences innovation performance and how this is affected by factors such as supply chain competence and absorptive capacity.

Secondly, the finding could help stakeholders and managers of pharmaceutical industry to understand the advantages out of the implementation of supply chain collaboration strategies such strategic relationship with supply chain partner and supplier involvement in NPD in terms of developing supply chain competence and absorptive capacity to improve innovation performance. This encourages pharmaceutical manufacturing industry decision-makers to implement supply chain collaboration strategies in an attempt to improve innovation performance to face the uncertainty in the market. This study will show whether current supply chain collaboration strategies are reliable strategies to enhance innovation performance.

1.10 Summary

This chapter highlights the primary challenges associated with the pharmaceutical industry supply chain. The present chapter outlines the aim, objectives, research questions, research problem, and significance of the study.

2 Chapter Two: Literature Review

This section starts with a theoretical overview of the theory of dynamic capabilities (also referred to as the dynamic capabilities theory) with a short history of the development of the theory being provided together with the formation of the concept. Moreover, this chapter outlines and presents the idea of innovation performance. In addition, supply chain collaboration strategies, including strategic relationship with supply partner and supplier involvement in NPD are examined. Finally, absorptive capacity's role is identified and discussed.

2.1 The Theory of Dynamic Capabilities

The theory of dynamic capabilities was originally proposed to identify the role that time plays in the development of competitive advantage, serving as an extension of the resource-based view of a firm (Teece & Pisano 1994). The theory of dynamic capabilities implies that alone, a firm's resources are insufficient to gain a competitive advantage and what is of greater importance is a firm's ability to identify specific resources and implement optimal routines that will generate a competitive advantage (Teece & Pisano 1994).

Teece and Pisano (1994) first introduced the theory of dynamic capabilities in order to outline the mechanism with which a firm is capable of reacting to external changes in its specific industry through innovative product development. Beyond this, the theory explains how firms can take advantage of external changes in a very dynamic environment, developing organisational capabilities in response to the changes that were occurring. The resource-based view of a business cannot account for this as, in principle, it assumes that resources alone are sufficient for a business to gain a competitive advantage. The theory of dynamic capabilities prioritises the organisational learning process that occurs as a consequence of a business collating and using information gleaned from its external environment (Teece & Pisano 1994). Thus, the role of management in an organisation and its ability to assess and adapt to external influences is critical for the success of any organisation. This also helps to explain why levels of success vary between firms, all other things being equal (Hacklin & Wallnöfer 2012; Wohlgemuth & Wenzel 2016).

Teece and Pisano's (1994) terminology was deemed as imprecise, which led to Teece et al. (1997) developing a model to further explain the theory of dynamic capabilities. Their model is shown in Figure 2.1.

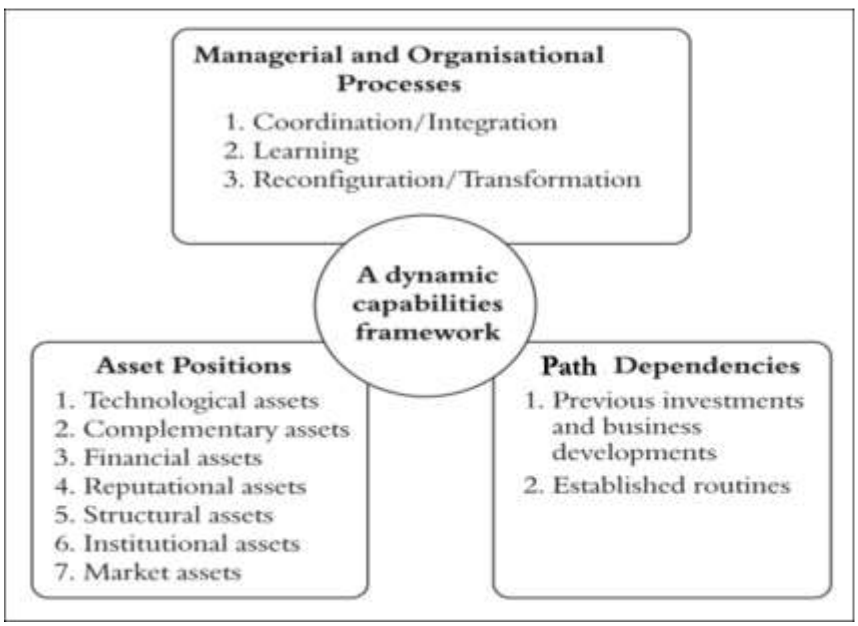


Figure 2.1: The model of dynamic capabilities

(Source: Teece et al. 1997)

Teece et al. (1997) highlighted that managerial processes are shaped through path dependencies. Path dependencies are the evolutionary processes firms have gone through and the routines which have been established since their commencement of operations. Asset positions have an effect on managerial and organisational processes as well and include a firm's resources which are irreplaceable and also non-imitable (Teece et al. 1997). Asset positions and path dependencies are both capable of influencing the way managerial and organisational processes are implemented, as outlined by Prahalad and Bettis (1986), "the way in which managers conceptualise the organisation and make critical resource allocation decisions in areas such as technology, development of new products, distribution, advertising and human resource management" (pp. 490-491).

Ambrosini and Bowman (2009) state that dynamic capabilities evolved from the theory of evolutionary economics, sharing commonalities with Nelson and Winter's (1982) work. Research carried out by Nelson and Winter (1982), as well as Teece and Pisano (1994), have a number of common points. Both of these studies have outlined the key importance of an organisation's internal resources in relation to the external market. Additionally, these studies have highlighted the role that internal routines established by an organisation play in creating a competitive advantage. These studies also share a common opinion on how important path dependencies, reconfiguration of internal capabilities, and optimum resource utilisation are as principal tools for effectively adapting to dynamic markets.

Additionally, the resource-based view theory was further extrapolated into the theory of dynamic capabilities. However, there is a major difference between the theory of dynamic capabilities and the resource-based view theory. The theory of dynamic capability predicts ongoing change and unpredictability, while resource-based view theory implies stability and continuity (Sminia 2014). Dynamic capabilities outline that an organisation's management must develop routines and path dependencies, enabling it to adapt to a continually changing external environment. Consequently, organisations mould themselves on path-dependent resources within the context of dynamic capabilities to ensure they can develop a sustainable competitive advantage (Prahalad & Hamel 1990). In conclusion, dynamic capabilities were drawn based on the theory of the growth of the firm (Augier & Teece 2007; Lockett & Wright 2005; Pitelis 2007) first promoted by Penrose (1959). Thus, together, the resource-based view of the firm and evolutionary economics provides the basis of the theory of dynamic capabilities.

2.1.1 Understanding the Theory of Dynamic Capabilities

The concept of dynamic capabilities is complex, so multiple researchers have tried to produce definitions which effectively help to explain the concept. The pioneering definition of dynamic capabilities was presented by Teece et al. (1997, p. 516), stating that dynamic capabilities are a "firm's ability to integrate, build, reconfigure internal and external competencies to address rapidly changing environments." Consequently, dynamic capabilities could be seen as those organisational capabilities that a firm creates or utilises which enable it to respond to its external environment. Augrier and Teece (2007) expanded this definition by outlining that a firm's ability to adapt must be inimitable for it is a dynamic capability. Additionally, Augrier and Teece (2007) state that in order to effectively respond to changes in its external environment, a firm needs to reconfigure its asset base.

Additional authors have tried to define dynamic capabilities, leading to the appearance of two categories of definition: dynamic capabilities as routines or resources, or dynamic capabilities as capacity or ability. Teece et al. (1997) outlined that dynamic capabilities are those capacities or abilities of a firm. Winter (2003) defined dynamic capabilities as the ability of a firm that can be utilized to modify or create standard capabilities within the firm. Zahra, Sapienza & Davidsson (2006) outlined that dynamic capabilities are seen as the capacity of the primary decision-makers in an organisation whose ideas can lead to the reorganisation of that firm's existing routines and resources.

Alternatively, Eisenhardt and Martin (2000), Felin and Powell (2016), and Zollo and Winter (2002) saw dynamic capabilities to be a set of processes or routines. Eisenhardt and Martin (2000, p. 1107) stated that dynamic capabilities: "are the organisational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die." Additionally, Felin and Powell (2016, p. 80) stated that dynamic capabilities are:

> "adaptive processes and structures that enable firms to change their baseline capabilities, anticipate shifts in market demand, develop and integrate new technologies, learn from market events, and foresee and capture new market opportunities".

Zollo and Winter (2002), have shown that dynamic capabilities are a particular set of processes which an organisation can use to reorganise its internal operating routines to become more effective.

While dynamic capabilities are seen as abilities or processes, the similarity in the above-discussed points is that dynamic capabilities enable a firm to utilise its internal capacities or routines to reorganise asset positions and adjust/alter them based on the external environment. Thus, dynamic capabilities' key role is to transform the internal capabilities of the firm (Di Stefano, Peteraf & Verona 2014; Felin & Powell 2016).

While multiple conceptualisations of the concept of dynamic capabilities exist, it is commonly agreed that the role of dynamic capabilities is to optimise the asset positions of the firm in order to develop a greater competitive advantage (Kor & Mesko 2013). Thus, the effectiveness of dynamic capabilities holds a more crucial position as opposed to just their presence (Ambrosini & Bowman 2009).

Dynamic capabilities allow a business to amass and create capital which can then be used to contribute to a process of renewal that could then boost the firm's performance (Eisenhardt & Martin 2000). Dynamic capabilities have the potential to be useful by enabling a firm to be highly responsive by swiftly and effectively repositioning itself while redeveloping its inimitable resources, even in disruptive times (Helfat 2007; Lin et al. 2016). Thus, the existence of dynamic capabilities in a firm is of immense value as they can create excellent opportunities for growth, even in uncertain markets.

Teece (2007) separated dynamic capabilities in an organisation into three dimensions: sensing, seizing, and transforming, all of which work simultaneously. When an organisation senses changes in the external environment, it can identify them, be the new opportunities or threats from competitors. Teece (2007) pointed out that such a capability is beneficial as the firm can adapt to globalization-related changes and changing consumer perspectives. Additionally, a firm must continuously survey its external environment, identify and make the most of the latest technological advancements, and pinpoint consumer needs. Profitability will be adversely affected if a firm fails to follow this course.

Creating an appropriate strategy once a new opportunity or threat has been identified is critical (Teece 2007). Finally, when a firm identifies and acts upon an opportunity, it must then adjust its asset position (Teece 2007). Simon (2002) notes that this transformation occurs when a firm achieves a state of equilibrium between swift adjustments and coordination of these changes. Coordination is a critical element needed to guarantee that a firm can implement innovative measures to optimize the use of emerging technologies (Chesbrough & Teece 2002).

2.1.2 Types of Dynamic Capability

Zero-level, first-order and higher-order are the three types of dynamic capability found in an organisation. Zero-level capabilities are those operational capabilities which enable a firm to operate successfully (Zahra et al. 2006). Operational excellence is a major tool for the creation of a competitive advantage, enabling a firm to perform well in areas such as production, product delivery, and/or design. Beyond this, first-order capabilities are a consequential result of zero-order capabilities, e.g., when a manufacturing firm sources its materials, this is a zero-order capability and the creation of relationships between that firm's suppliers and customers are first-order capabilities (Setchi et al. 2014). Any subsequent modification and adaptation of Zero-level and first order are seen as higher-order capabilities (Zollo & Winter 2002).

Previous research has identified and created a number of differing classifications for organisational capability. Collis (1994) classified four of them: first-order, second-order, third order, and meta-capabilities, while Winter (2003), classified them as: zero-level, first-order, and higher-order capabilities. Ambrosini et al. (2009) classified dynamic capabilities as being resource-based, incremental, renewing, and regenerative. Zahra et al. (2006) provided only two categories: substantive and dynamic capabilities, as did Felin and Powell (2016) individual and collective.

Other dynamic capability categories presented have also been proposed. Cui and Jiao (2011) identified that a strategic alliance is a form of dynamic capability where a firm which creates strategic alliances as a type of dynamic capability can identify and reconfigure its internal technological capabilities. Cui and Jiao (2011) pointed out that strategic alliances allow businesses to better access new markets and optimise operational efficiency. Kale et al. (2009), produced similar findings, reporting that the existence of strategic alliances result in appreciable performance growth of businesses.

With the world increasingly becoming a knowledge-based economy, appropriate knowledge and knowledge-based resources have become essential resources for businesses to gain a sustainable, competitive advantage (Zheng et al. 2011). Knowledge-based dynamic capabilities enable businesses to react appropriately to external changes while also updating their knowledge base (Ambrosini & Bowman 2009). According to Zheng et al. (2011), knowledge acquisition, knowledge generation, and knowledge combination capabilities are all knowledge-based dynamic capabilities which can positively affect the strategic market advantage and efficiency of a business as they improve the business' innovation performance by increasing the amount of resources used (Zheng et al. 2011).

Multiple researches have been performed on IT capability as a form of dynamic capability. The theory of dynamic capabilities shows that capabilities are deemed to be dynamic when they are firmly rooted in a business, are difficult to imitate, while also being irreplaceable (Fang & Zou

2009; Teece et al. 1997; Vorhies et al. 2011). Teece (2007) maintained that dynamic capabilities can lead to the development of new skills/areas of expertise, products, or services as a consequence of a shift in the resource base. This can then generate new opportunities in the marketplace and improved results for businesses. Teece (2014) also noted that dynamic capabilities improve performance, especially in fast-paced environments.

Literature reveals that with dynamic capabilities that are IT related, this can have a major influence on a business' ability to gain a competitive advantage in permanently changing environments (e.g., Bhatt & Grover 2005; Clark et al. 1997; Santhanam & Hartono 2003). Santhanam and Hartono (2003) have proposed that businesses with dynamic technological capabilities can create efficient and cost-effective systems based on market experience. Being able to predict customer needs more rapidly than the competition creates a strategic advantage. Additionally, Clark et al. (1997) revealed that businesses with highly experienced IT-based marketing groups can efficiently create and utilise key elements which can positively affect future competitive advantages. In both cases, competitive advantages have not been created by technological advances alone, but through the skills, experience and capability of those utilising the technology.

Multiple studies on SMEs have also identified that the competitive benefit of IT capability is directly connected to a business' success. Chan et al. (1997) found effective use of information systems (IS) creates a competitive advantage which can enhance profitability through a combination of improved productivity, market growth, better innovation levels, and enhanced reputation. Ashrafi and Mueller (2015) also showed that revenue growth, market efficiency, and better operating performance could be achieved by firms which adopted IT-enabled competitive advantage strategies.

In addition, previous studies have identified additional forms of dynamic capability, including R&D (Helfat 1997), product innovation (Danneels 2002), knowledge acquisition (Karim & Mitchell 2000), organisational restructuring (Karim 2006), co-creation capacity (Wilden et al. 2019), integration, sensing, and reconfiguration (Zhou et al. 2017), supply chain flexibility (Blome et al. 2013; Gligor, Esmark & Holcomb 2015; Tenhiälä & Helkiö 2015), absorptive capabilities (Wang & Ahmed 2007), and network capabilities (Cui & Jiao 2011; Walter et al. 2006). Additionally, Vanpoucke et al. (2014, p. 2) demonstrated that supplier integration capability is a form of dynamic capability because it contains "processes to achieve effective and efficient product and information flows between buyers and suppliers." Additionally, Winter (2003) and Verona and Ravasi (2003), have also shown that new product development is a form of first-order dynamic capability.

Zahra and George (2002) showed that knowledge management and absorptive capacity are forms of dynamic capability which can result in achieving a sustainable competitive advantage by enabling a firm to effectively use knowledge creation and deployment. Additionally, embedding absorptive capacity also empowers the establishment of valuable and inimitable routines leading to an improved ability to recognise new market developments, leading to innovative outcomes (Gassmann, Enkel & Chesbrough 2010). These innovative outcomes are only considered dynamic providing they generate long-term capacity within the firm to adapt to an ever-changing external environment (Teece et al. 1997). Thus, simply normal and basic R&D and product innovation are not automatically part of a dynamic capability framework. Innovative capabilities of a firm can remain unchanged and therefore fail to lead to dynamic capabilities as they lack the necessary transformative nature, which is capable of reinterpretation, reconfiguration, and reshaping of existing firm's resources (Lawson & Samson 2001).

While multiple forms of dynamic capabilities exist, research in the context of supply chain is limited (Masteika & Čepinskis 2015). From the author's research, it would appear that dynamic capabilities and supply chain are directly connected, the result being a supply chain that is very flexible and dynamic, with the ability to adapt to constantly changing market demands. Masteika and Čepinskis (2015) were among the first to identify a clear connection between dynamic capabilities and the supply chain, which this study expands upon.

2.2 Innovation Performance

Innovation performance is a key element which enables organisations to achieve a higher competitive advantage and improve its chances of survival in a dynamic environment (Jiménez-Jiménez & Sanz-Valle 2011; Zimmermann et al. 2016). One of the most-popular definitions of innovation was used by Schumpeter (1996 p. 66):

> "a new product, a new technology for an existing application, a new application of technology, the development or opening of new markets, or the introduction of new organisational forms or strategies to improve results".

Since dynamic capability theory was conceptualized, it has been connected to the generation of innovation (Eisenhardt & Martin 2000; Teece et al. 1997). Innovation is a key factor driving organisational renewal and success (Danneels 2002) and is proven to improve financial performance and increase competitive advantage (Sharma & Lacey 2004). However, other studies show that unless innovation is correctly managed, it can lead to failure, disrupting both the business and also the supply chain (Lichtenthaler & Lichtenthaler 2009; Mahajan, Muller & Wind 2000). Thus, successful innovation is contingent upon the operational capabilities of a firm (Brown & Eisenhardt 1995; Danneels 2002; Galunic & Rodan 1998; Simpson et al. 2006; Teece 1986; Verona 1999). However, it has been shown that innovation performance can be affected differently depending on the capability (Spanos & Lioukas 2001). Additionally, combining capabilities can also have a major impact on a firm's performance, i.e., combining marketing and technological capabilities can result in better innovation than if deployed independently (Song et al. 2005). As innovation presupposes the development of new technologies or solutions to meet customers' needs or to solve complex problems (Andriani, Ali & Mastrogiorgio 2017), there also needs to be organisational capabilities such as R&D, business development, and production present.

Dynamic capabilities enable firms to ensure that they are capable of identifying, obtaining, and integrating appropriate knowledge which can allow a firm to react to and reconfigure its internal resources (Eisenhardt & Martin 2000; Teece 2007). This is achievable as dynamic capabilities expand on operational capabilities and the reconfiguration of internal resources (Helfat 2007). So, it can be said that dynamic capabilities enable firms or organisations to enhance the quality and strength of their resource configuration (Pavlou & El Sawy 2006). Additionally, those possessing dynamic capabilities have the ability to constantly and accurately monitor their resources and reconfigure their internal capability of meeting external demands (Teece 2007). Thus, it can be said that dynamic capabilities have a positive influence on the development of capability, i.e., dynamic capabilities can improve upon ordinary capabilities which can result in enhanced innovation performance (Drnevich & Kriauciunas 2011).

From the above, it has been shown that dynamic capabilities are the foundations of a firm's or organisation's innovation performance. By improving resource reconfiguration capacity, innovation performance is indirectly enhanced by dynamic capabilities (Eisenhardt & Martin 2000; Helfat & Peteraf 2009). The requirements of innovation performance can be fulfilled with the help of dynamic capabilities, which enable a firm to not only identify relevant information, but also interpret it and determine its usefulness for the business as a whole (Danneels 2008; Teece 2007).

2.2.1 Previous Studies on Innovation Performance

While numerous typologies of innovation exist, most studies have focused on product, service and process innovation (Chong et al. 2011; Chen & Tsou 2007; Gobeli & Brown 1994; Prajogo & Sohal 2001; Yamin et al. 1997). In line with existing literature, this study focuses on innovation performance as a unidimensional construct which includes innovation of processes, products, and services.

In the context of the supply chain, Narasimha and Narayanan (2013) define innovation as that process which generates changes in services, products, or processes, creating new value for the firm which, through knowledge sharing, is passed on to customers. Innovation is found to be strongest element when resulting from collaboration and collectiveness with outside firms (Radas & Božić 2009). Additionally, Fawcett et al. (2012) state that there is a considerable advantage that firms get when collaborating with external partners, as the potential then exists to generate a higher level of innovation. Thus, in the context of the supply chain, firms will look to supply chain partners for innovation. Through the supply chain, firms can internally and externally share information, thus providing the opportunity to improve on innovative performance. This is backed up by

Utterback (1978) and Roffe (1999) who discussed that innovation occurs in an organization through good communication. Thus, it would be of interest to investigate if supply chain collaboration strategies, including strategic relationship with supply chain partner and supplier involvement in NPD, can benefit innovation performance.

Zimmermann, Ferreira and Moreira (2016) proposed a model which synthesised the principal practices identified for improving innovation performance via the supply chain, while identifying three supply chain approaches/strategies: Integration for New Product Development and Process, Strategic Alignment and Open Innovation. These relate to the principal facilitators of innovation performance, including supply chain /strategies studied. Based on the studies analysed for their literature review, the model proposes features and strategies that tend to have a positive effect on a firm's innovation performance.

Bellamy et al. (2014) demonstrated that most businesses which engage in innovation-related collaborations achieve improved innovative output. Supply chains and supplier relations play a significant role within the innovation process (Bellamy et al. 2014). The interactions generated result from two important types of relationships in a supply chain. This includes an alliance agreement and a supply agreement, with the alliance agreement on firm-level innovation resulting in mutually beneficial results (Bellamy et al. 2014).

Chong et al. (2011) found that there is a strong relationship between supply chain management practices, which also includes strategic relationship between supply chain partner, and innovation performance. After the implementation of supply chain management practices, firm productivity improves, and customers' needs are more effectively met (Chong et al. 2011). The study also identified that firms with high levels of innovation performance tend to have high levels of organizational performance.

Multiple studies have explored the relationships between total quality management practices and innovation performance (Prajogo & Sohal, 2001, 2004; Singh & Smith 2004). These studies assessed whether total quality management practices increase the level of innovation in firms. Prajogo and Sohal (2001) attempt to investigate whether total quality management promotes or hinders innovation. Beyond the relationships between total quality management and innovation performance, there has been limited research into relationships between supply chain collaboration strategies and innovation performance in the context of the pharmaceutical industry.

Moreover, it could be shown that innovation capabilities of firms create opportunities for product innovation and lead to greater success (Yam et al. 2010). Yeşil, Koska and Büyükbeşe (2013) demonstrate that innovation capability has a significantly positive effect on a firm's innovation performance. This result provides insight into related studies of (Calantone et al. 2002; Lee & Liu 2008; Richard et al. 2010; Shan & Jolly 2012), which show that there is a strong connection between a firm's innovation capability and innovation performance and therefore they need to continuously increase and improve their creative innovation capabilities.

Previous studies promote two of the most common factors which enable the development and success of innovation, namely knowledge acquisition and knowledge assimilation (Cohen & Levinthal 1990; Tsai 2001). Past research shows that knowledge acquisition, creation, and sharing are connected with sustainable innovation performance as innovation is associated with providing customers with new products or solutions or developing new operational procedures (Verona &

Ravasi 2003). Alternatively (Alavi et al. 2005-2006; Aulawi et al. 2009; Fang et al. 2007; Yang & Wu 2008) suggests there is a strong connection between knowledge sharing processes, innovation performance, and firm performance, while Yeşil, Koska and Büyükbeşe (2013) have shown that the knowledge-sharing process does not affect innovation performance. Thus, there is inconclusive conclusion on the connection between knowledge sharing and innovation performance.

Previous studies have examined the importance of absorptive capacity where innovation performance is concerned (Prahalad & Hamel 1990; Kostopoulos et al. 2011; Lau & Lo 2015). Literature argues that absorptive capacity can moderate innovation performance (Kostopoulos et al. 2011; Wijk et al. 2008; Kodama 2008; Wagner 2012). Maurer, Bartsch & Ebers (2011) showed that absorptive capacity can be related to innovation performance, i.e., that element of organisation learning associated with dynamic capabilities enables the creation and acquiring of new knowledge and integrates knowledge from multiple sources through integration (Augier & Teece 2008; Cohen & Levinthal 1990; Kogut & Zander 1992; Zahra & George 2002).

In addition, the innovation phase relies heavily on external knowledge sources (Cohen and Levinthal, 1990). Firms with a poor absorptive capacity will struggle to assimilate and commercialise new information, thus hindering innovation performance (Foss et al. 2011; Onyeiwu 2015). Hong et al. (2019) showed that absorptive capacity plays a major role in the relationship between collaborative innovation and innovation performance in an organization-to-organization and organization-to-institution setting. Consequently, one can conclude that absorptive capacity is derived from open connections to external knowledge channels (Lewandowska 2015) which, together with robust learning (Cohen & Levinthal 1990; Thornhill 2006; Vinding 2006) are key success factors when it comes to increasing innovation performance and commercialising innovation.

Recent studies have shown that collaboration between external environments and the incorporation of novel information can result in better innovation efficiency (Awwad & Akroush 2016; Hsieh & Chou 2018; Szücs 2018; Zach 2016). With an absorptive capacity, firms can develop services or goods using new expertise (Paiva, Gutierrez & Roth 2012) and organizational learning (Olavarrieta & Friedmann 2008). Consequently, absorptive capacity is a key element which provides a sustainable increase in innovation performance.

Though innovation performance is not a new concept, gaps in the research still exist. However, what can concretely be determined from existing literature is that there is the need for innovation performance in a firm so it can maintain an innovative edge and ensure that it is able to adjust to changing market needs. However, the connection between innovation performance and supply chain in the context of the pharmaceutical industry has neither clearly nor extensively been established. While there are multiple previous studies that have evaluated the impact on innovation performance of supply chain strategies/approaches (Zimmermann et al. 2016), management practices (Chong et al. 2011), supply chain collaboration (Fawcett et al. 2012), supply chain total quality management (Prajogo & Sohal 2001, 2004), absorptive capacity (Prahalad & Hamel 1990; Kostopoulos et al. 2011) innovation capability (Lee & Liu 2008; Yam et al. 2010), and knowledge sharing (Alavi et al. 2005; Aulawi et al. 2009; Fang et al. 2007; Yang & Wu 2008) , there is little research that focuses on the relationship between supply chain collaboration strategies, supply chain competence, and innovation performance, or a combination of some or all of these concepts. Furthermore, as previously mentioned, there is ample literature on absorptive capacity and innovation performance, but with no definitive or conclusive results. The next section will discuss supply chain collaboration strategies.

2.3 Supply Chain Collaboration Strategies

Literature on supply chain management places an increasing emphasis on treating suppliers as key supply chain partners (Cousins et al. 2008; Jajja et al. 2016; Soh et al. 2016). This idea is grounded on the broader coverage in management literature such as the relational view (Dyer & Singh 1996) and a focus on the capability of firms to manage their external business-to-business relationships (Möller & Törrönen 2003; Mitrega et al. 2012). Recently, greater emphasis has been placed on suppliers as the source of knowledge for innovation (Stubrin 2017; Tether 2002) and on their role as partners in collaborative innovation (e.g., Chapman & Corso 2005; Kim 2016; Rosell & Lakemond 2012). Businesses look for a collaboration with supply chain partners where each contributes value and where their combined skills produce results that are better than were each of the partners were to operate independently (De Leeuw & Fransoo 2009; Spekman et al. 2002, p.41).

Arora, Arora and Sivakumar (2016) noted that some of the most important supply chain collaboration strategies are strategic relationship and collaboration or integration. These strategies were chosen because they define the ability of a firm to sense, seize, and reconfigure their assets (Arora, Arora & Sivakumar 2016). Beyond this, supplier management involving relational practices has been shown to result in improved supply chain performance (Salam & Khan 2018). Additionally, supplier-buyer relationship practices have been shown to increase a firm's profitability and lead to greater competitive advantages (Joshi et al. 2017). Zimmermann et al. (2016) identified five strategies through a systematic literature review: "(i) partnerships for specific purposes; (ii) projects coordinated by the client firm; (iii) involvement of suppliers for NPD and processes; (iv) the strategic relationship with supply chain partner; (v) open innovation strategy" (p. 299). Another study by Soosay and Hyland (2015) conducted an iterative systematic review of supply chain collaboration of research conducted from 2005 until 2014. After developing a structured definition of supply chain collaboration, the review by Soosay and Hyland (2015) outlined that there are three primary types of collaboration that occur: horizontal, lateral, and vertical. Furthermore, the review also revealed some areas in which supply chain collaboration is gaining increasing importance: collaboration for increasing sustainability, collaboration for humanitarian supply chains, and collaboration for technologically enabled supply chains. It can be noted that these are merely areas of growing focus and research that were identified by Soosay and Hyland (2015) and do not represent strategies that an organisation needs to undertake to influence innovative performance. In the words of Soosay and Hyland (2015), "Our review of the literature sought to address how well the body of knowledge on supply chain collaboration corresponds with our contemporary society and also to provide a discussion on areas for future research" (p. 622). Thus, the aim of the research conducted by Soosay and Hyland (2015) remained with the identification of how the body of knowledge in supply chain collaboration has progressed. The authors did not focus on providing prescriptive strategies that companies can adopt to benefit them achieve a wide range of objectives. The only prescriptive advice that Soosay and Hyland (2015) have provided scholars is the need to include multi-tier perspectives in future research and the need to include consumer input to co-create value. Another criticism of Soosay and Hyland (2015) is that their focus was on generic supply chain management research and did not focus on any one significant area of research. On the other hand, the study by Zimmerman et al. (2016) set out to identify specific strategies that can be implemented by companies that are focused on enhancing their innovation performance. Not only was their focus on identifying specific strategies, but they also focused on a specific outcome which is also the focus in this research: innovation performance. In the words of Zimmerman et al. (2016), "The question the paper aims to answer is: considering that the innovation process is affected by external factors, how do supply chains affect the innovation process and performance?" (p. 289). In other words, the study by Zimmerman et al. (2016) focused on identifying "how" innovation performance can be enhanced in the supply chain. Furthermore, the specific research question that Zinnerman et al. (2016) set out to answer was, "What are the main approaches or strategies used within the supply chains to manage or enhance the innovation process?" (p. 289). Therefore, the focus of the study by Zimmerman et al. (2016) was prescribing strategies that can enhance the innovation process. As such, Zimmermann et al. (2016) identified the three major supply chain strategies/approaches that generate long term benefits for a business as: open innovation, involvement of suppliers in new product development, and strategic relationship that positively affect a firm's innovation performance. According to Zimmermann et al. (2016), businesses typically benefit from a strategy which involves suppliers in NPD, and strategic partnerships. Dowlatshahi (1998), Handfield et al. (1999), Johnsen (2009), van Weele 2018 and Zsidisin and Smith (2005) have stated that supplier involvement provides a purchasing enterprise with the chance to integrate its suppliers at an early stage in the process of new product development.

Furthermore, Wang and Jie (2019) outlined that the pharmaceutical industry needs to focus on supply chain integration and the forming of strategic relationship. The industry needs to reduce uncertainty and risk. This is because the pharmaceutical industry is heavily dependent on continuous R&D. It has been estimated that it takes upwards of ten years to develop a new drug

(Mullin 2014). Consequently, pharmaceutical firms need to engage in relationship-based strategies involving their supply chains in order to develop and commercialize innovative products (Yoon et al. 2018). These supply chain collaboration strategies have become critical to the success of the pharmaceutical industry, or ‘big pharma’.

While the strategies included in this research cover major supply chain management strategies, the list of strategies is incomplete. Additional strategies identified in literature (e.g., open innovation) have not been included in this research. Although the excluded strategies are of considerable interest, they have not been included owing to “the length of the survey, and the concerns regarding the parsimony of measurement instruments”. Based on previous research, strategic relationship with supply chain partner and supplier involvement in NPD can be seen as supply chain collaboration strategies that, consequently, are connected to supply chain competence and innovation performance.

Furthermore, while there are inherent differences between the study by Soosay and Hyland (2015) and Zimmerman et al. (2016), they both have identified the importance of supply chain collaboration, whereby Zimmerman et al. (2016) further identifying specific strategies that firms can actually implement to increase innovation performance. These two strategies include strategic relationship with supply chain partner and supplier involvement in NPD and thus have been adopted in the present research. With the prevalence of these two strategies and their important connection with innovation performance, combined with a considerable lack of studies on the role on supply chain competence from the perspective of dynamic capabilities, they have been chosen for further research in this paper.

2.3.1 Strategic Relationship

The value of external sources of information and knowledge for firms is immeasurable as it is impossible for any business to possess all capabilities for its success (Caloghirou, Kastelli & Tsakanikas 2004; Powell et al. 1996; Rosenkopf & Nerkar 2001). Extensive research has shown that strategic relationship is a part of a mechanism enabling firms to learn and gain access to external knowledge covering multiple different types of strategic relationship (Caloghirou, Kastelli & Tsakanikas 2004; Drewniak & Karaszewski 2020; Hagedoorn 1993; Hamel 1991; Inkpen 2000; Inkpen & Dinur 1998; Yang et al. 2015). The development of strategic alliances with co-operative firms is one of the most commonly deployed strategic relationship (Cravens, Shipp & Cravens 2006).

Multiple factors influence the overall outcome of strategic relationship. As examples, the organisational learning capabilities of a firm, the magnitude of the relationship in relation to the number of partners, the attributes that govern strategic relationship, the relational capability, and the level of relationship management all influence strategic relationship created by partner (Ahuja 2000; Davis & Eisenhardt 2011; Heimeriks & Duysters 2007; Kale et al. 2000; Koka & Prescott 2008; Owen-Smith & Powell 2004; Parise & Casher 2003; Phelps 2010).

Owing to the importance of establishing strategic relationship with partner, the capability of developing, managing, and leveraging strategic relationship has been extensively studied in such areas as entrepreneurship, strategic management, and business marketing (Felzensztein et al. 2014; Gunasekaran, Lai & Cheng 2008; Möller 2013; Palmatier, Miao & Fang 2007). The volume of interest in establishing strategic relationship is because the forming of alliances, partnerships, and coordinating across value chain partners is virtually a necessity for innovation and optimised business performance (Lambe, Spekman & Hunt 2002; Möller 2013; Niesten & Jolink 2015; Ritter & Gemünden 2004; Soosay, Hyland & Ferrer 2008). Beyond this, the ability for firms to amass knowledge and to be involved in learning opportunities can result in the development of value co-creation, enhanced performance, and innovative outcomes (Sluyts et al. 2011).

Based on the context of the research, strategic alliances or strategic relationship is defined differently (Cravens, Shipp & Cravens 2006). For example, in strategic management, strategic relationship is called alliance capabilities (Kale & Singh 2007; Wang & Rajagopalan 2015), while in marketing, it is called relational competency or capability (Phan, Styles & Patterson 2005; Storey & Kocabasoglu-Hillmer 2013). In supply chain literature it is referred to as a strategic alliance which, according to Zimmermann, Ferreira and Moreira (2016, p. 12) is the process of maintaining "long-term partnerships between supply chain actors."

In relation to dynamic capabilities, the formation of strategic relationship with external partners can result in the creation of competitive advantages as a result of the competencies and internal routines of those firms (Kraaijenbrink, Spender & Groen 2010). Such competencies and internal routines have been identified as the function of the alliance, the routines of alliance, the activities, and the tools used (Eggers & Kaplan 2013; Felin et al. 2012). In such a context, the processes which occur are frequently referred to as practices or micro-processes (Argote & Ren 2012; Vesalainen & Hakala 2014; Wang & Rajagopalan 2015). These micro-processes and practices can enable an organisation to use its competencies to further facilitate inter-departmental resource sharing (Kraaijenbrink et al. 2010). This sharing can create a competitive advantage, which is essential in the context of dynamic capabilities (Kraaijenbrink et al. 2010).

In the context of strategic relationship, multiple processes, including knowledge sharing and assimilation, relationship scorecards, organisational meetings, and bonding opportunities encourage and enable resource sharing which can be of considerable benefit to supply partners (Kohtamäki, Rabetino & Möller 2018; Niesten & Jolink 2015). To this end, previous research sees the ability to form strategic relationship as a form of higher-order dynamic capability (Kale & Singh 2007; Kohtamäki, Rabetino & Möller 2018; Niesten & Jolink 2015). This is because:

> "dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets (Teece 2007, p. 1319)"

Thus, as a dynamic capability, firms can access information and knowledge from their strategic partners, as well as reconfiguring the organizational assets. Organisational learning is of crucial importance within strategic relationship, as organisational learning ensures that there is effective knowledge sharing and development necessary for any strategic relationship to create value (Niesten & Jolink 2015). Previous research has identified that, to a certain extent, experience which firms gain in forming and managing strategic relationship with external partner regulates the volume of learning that can occur in an organisation (Kohtamäki, Rabetino & Möller 2018). According to Zhang et al. (2020), organisational learning is a core concept of dynamic capability.

2.3.1.1 Previous Studies on Strategic Relationship

Relational capabilities of an organisation in a strategic relationship can create a greater degree of knowledge absorption, resource reconfiguration, and innovation enhancement, while also producing improved performance outcomes (Asree, Cherikh & Gopalan 2018; Battor & Battor

2010; Ritter & Gemünden 2003, Tzokas et al. 2015). Additional studies have shown that strategic relationship can result in improved performance outcomes, such as a boost in sales (Walter et al. 2006), an improved R&D rate (Kohtamäki, Rabetino & Möller 2018), better project performance (Mishra & Shah 2009), and an improved environmental and sustainable performance (Luzzini et al. 2015; Paulraj 2011). The outcomes of strategic relationship can vary depending on the nature of the relationship. For instance, successful strategic relations can result in abnormal stock market returns (Kale, Dyer & Singh 2002), enhance the rate of a joint action, improve a firm's status, improve customer knowledge (Schreiner et al. 2009), and increase customer satisfaction and supplier performance (Kim 2009), as well as improve profit margins (Morgan, Slotegraaf & Vorhies 2009). Furthermore, good strategic relationship can result in better responsiveness, improved credibility, or better-quality products or services (Chen, Su & Ro 2017; Johnson, Sohi & Grewal 2004; Theoharakis, Sajtos & Hooley 2009).

Beyond this, certain outcomes of strategic relationship can involve successful and a higher rate of innovation, improved product quality and performance, development of new products, and the creation of customer value (Battor & Battor 2010; Berghman, Matthyssens & Vandenbempt 2006; Fawcett et al. 2012; Lages et al. 2009; Ritter & Gemünden 2003; Sivadas & Dwyer 2000).

A firm can enhance the impact of a supply chain partner's innovativeness on its product innovation strategy by developing a strategic relationship with the supply chain partner and creating a climate of innovation (Oke et al. 2013). Thus, supply chain partner innovativeness can exert a positive influence on a firm's product innovation strategy. This influence can be enhanced by forging stronger strategic relationships with supply chain partners, as well as by combining the effects of these strategic relationships and innovation climate (Oke et al. 2013). However, Oke et al. (2013)

did not evaluate how innovation performance in the pharmaceutical industry is affected by strategic relationships with supply chain partners.

While previous researches have explored and examined the outcomes of strategic relationship on, for example, organisational performance and innovation success, as far as the author is aware, none have focused on the context of the pharmaceutical industry. Additionally, the author could find no studies which focused on combined strategic relationship and supply chain competence as a mediator leading to improve innovation performance.

2.3.2 Supplier Involvement in NPD

Dowlatshahi (1998) defined supplier involvement as the integration of supplier capability within product development. Supplier involvement in this context involves all parties pooling their expertise to achieve a strategic objective related to product development. According to Luzzini et al. (2015) the most recent concept of supplier involvement in NPD relates to handling suppliers' involvement within a specific group in the production of new goods, materials, technology, and systems. Consequently, supplier involvement in the concept of NPD encompasses method design and configuration of a new supply chain.

Because of growing complexity and levels of competition in today’s marketplace, firms need to continuously develop new products to gain or maintain a competitive advantage (Gonzalez-Zapatero et al. 2016; Marzi et al. 2020; Mu et al. 2017; Najafi Tavani et al. 2013). However, NPD is a hugely complex and resource-intensive process which may not produce anticipated outcomes (Liang, Kale & Cherian 2014). A key driver for the success of NPD is the successful collaboration of members of the supply chain, plus the ability to leverage external resources and capabilities (La

Rocca et al. 2016; Menguc, Auh & Ozanne 2010; Mu et al. 2017; Tsai 2009). Marzi et al. (2020) revealed that one of the most recent trends in NPD is the importance of integration to enable access to diverse knowledge sources. Furthermore, Marzi et al. (2020) showed that firms are placing increased emphasis on supplier involvement in NPD to activate a knowledge-sharing process which is key to successful product innovation.

Technological evolution and automation have resulted in a shorter product lifecycle (Song & Montoya-Weiss 2001), where firms now have to establish more effective means of developing new products (Takeuchi & Nonaka 1986), as the key for successful NPD is the ability to rapidly respond to changing or emerging demand, and to swiftly rectify any errors (Menon, Chowdhury & Lukas 2002). Thus, the concept of dynamic capabilities becomes highly relevant. Consequently, the use of dynamic capabilities as a theory on NPD performance has been proposed (Darawong 2019; Pavlou & El Sawy 2011). Pavlou and El Sawy (2011) suggested that having dynamic capabilities to produce, disseminate, and adapt to business information (sensing capacity), NPD systems increase the likelihood of a business being able to rapidly introduce new goods or services that better meet consumer needs (technical capability), thus facilitating sales (customer capability). Additionally, Pavlou and El Sawy (2011) point out that in swiftly acquiring new knowledge on technology advancements (learning capability), NPD systems increase the opportunities for the production of new goods utilizing the latest technology (technical capability). Additionally, through the effective incorporation of information and relationship dynamics (integrating capability) and effectively organising personnel, projects, and events (coordinating capability), it is more likely that NPD units will be able to effectively administer new NPD activities through the tracking of success, designing rewards, and resolving internal tensions (managerial capability)

(Pavlou & El Sawy 2011). Thus, it is proposed that the capability to continuously reconfigure NPD processes is not solely connected with a firm's level of success in a dynamic environment, but it is also connected to a superior NPD performance (Gumusluoglu & Acur 2016; Pavlou & El Sawy 2011). Developing certain capabilities such as sensing the environment and learning, coordinating, and integrating resources, enable a business to adapt to and respond more effectively and efficiently to a changing environment, thus enabling improved NPD efficiency and new product effectiveness (Pavlou & El Sawy 2011).

2.3.2.1 Previous Studies on Supplier Involvement in NPD

Previous research has underlined the importance of supplier involvement in NPD as a tool for integrating their valuable feedback and expertise into the development process (Jean, Sinkovics & Hiebaum 2014; Menguc, Auh & Yannopoulos 2014) through the deployment of a sensing capacity. Multiple studies have concluded that supplier participation is a process (Laursen & Andersen 2016) that involves the continuous incorporation of skills and information obtained via the supply chain (Lusch 2011) thus creating a capacity for coordination. Additionally, literature has shown the importance of external influences on new product production (Nambisan et al. 2017; Laursen & Salter 2006). Past studies have demonstrated the need for innovation to be disseminated across supply chain partners (Yeniyurt et al. 2013). As producers and suppliers have their own, individual areas of experience, they can enhance each of their growth-related activities by combining their key skills (Jean et al. 2014). Comprehensive information exchange and increased knowledge can lead to improved NPD performance (Hu, McNamara & Piaskowska 2017).

Most previous research suggests that the more a business invests in NPD, the greater the benefits are for that business and its customers (Bakhshi & McVittie 2009; Chen & Stewart 2010; Frohlich & Westbrook 2001; Lin, Chen & Yeh 2014; Nagashima et al. 2015; Scholten & Schilder 2015; Tan, Kannan & Handfield 1998; Valkokari, Paasi & Rantala 2012).

According to Salvador and Villena (2013), the principal reason for such an integration is to reduce costs and mitigate for risk. Moreover, Pero et al. (2010) state that the chances of failure are lowered when working in an integrated network as there is less chance of supply disruption. The overall benefit for the purchaser in a supply network can be positively affected by high levels of supplier involvement in NPD (Bonaccorsi & Lipparini 1994). Additionally, supplier involvement in NPD can lead to improved productivity, better time efficiency, and cost reduction for NPD development, plus seamless knowledge dissemination across the whole organisation (Van Echtelt et al. 2008). Supplier involvement in NPD ensures sustained success for the purchasers in a supply chain network because it can positively influence the time, cost, quality, and overall performance of the NPD process (Danese & Filippini 2010; Petersen, Handfield & Ragatz 2005; Handfield & Lawson 2007; Suurmond, Wynstra & Dul 2020; Wagner 2012; Wasti & Liker 1999).

Zimmermann, Ferreira and Moreira (2016) identified the process of supplier involvement in NPD as a key element of enhanced innovation performance. Successful innovation usually comes from collaboration as opposed to independent effort, and thus purchasers in the supply chain can gain access to external capital in an effort to gain a competitive advantage through the involvement of suppliers through their NPD process (Luzzini et al. 2015). Successful supplier involvement in NPD is achieved through effective information sharing across the supply chain, thus facilitating joint decision making for effective NPD (Petersen et al. 2005). This underlines that the role of suppliers in the NPD process is more important than had been previously believed (Dröge, Jayaram & Vickery 2000). In addition, the close involvement of suppliers can be of benefit to information exchange and corporate learning (Dyer & Nobeoka 2000; Sobrero & Roberts 2001).

Kessler and Chakrabarti (1996) propose that supplier involvement in NPD has several advantages. To begin with and as a member of the production team, supplier involvement in NPD increases levels of experience and knowledge relating to innovative product concepts and technology (Chakrabarti et al. 1989), plus helping to spot and overcome potential issues in the early stages (Wasti & liker 1999). Second, communication coordination, and knowledge exchange are assisted, thus reducing delays (Sikora & Shaw 1998). Thirdly, supplier involvement in NPD can help to minimize instances of reworking (Combs & Ketchen 1999).

According to Handfield et al. (1999), supplier involvement in NPD can cut production time and reduce costs, improve efficiency, and could lead to innovative solutions to augment market share (McGinnis & Vallopra 1998; Ragatz, Handfield & Scannell 1997). Effective supplier involvement leads to reduce production costs and an increase in the value of the products. It can be achieved through the embracing and use of supplier resources (Wynstra van Weele & Weggemann 2001).

Alternatively, Birou (1994) claim that supplier involvement during the NPD phase does not always guarantee increased project effectiveness and productivity. According to Hartley, Meredith, McCutcheon, and Kamath (1997) supplier involvement in NPD has minimal effect on the overall performance of a project. Wynstra and Pierick (2000) argued that while supplier involvement is not detrimental in nature, it must still be managed carefully. Additionally, Johnsen (2009); Primo and Amundson (2002) propose that management creates significant obstacles to supplier involvement. In research into the efficacy of NPD project teams, Petersen et al. (2005), interviewed engineers in manufacturing firms, revealing that most engineers were uncomfortable with the inclusion of an additional member on their NPD team, as this required additional sharing and discussing of technological details.

In their study on supplier collaboration practices related to innovation performance Kähkönen et al. (2017), show that early supplier involvement did not affect innovation performance. Moon, Johnson & Cullen (2018) investigated the relationships between supply chain participants throughout the process of NPD and innovation outcomes. Results showed that there was either a negative influence, or no influence at all on innovation performance through supplier involvement.

While there is an increasing amount of research assessing the critical nature of supplier involvement in NPD, not all results are significant. While the role of suppliers in NPD is significant for the development of supply chain competence in areas such as quality, service, distribution, and innovation, there is a gap in the literature and research relating to supplier involvement in NPD in the context of a pharmaceutical supply chain. It should be pointed out that it is unclear whether additional factors exist which can affect the connection between supplier involvement in NPD and innovation performance. The next section will discuss supply chain competence.

2.4 Supply Chain Competence

According to Handfield and Nicholas (1999) supply chain management has now embraced a competitive reality. This is as a result of the shift of competition solely between businesses and now involves competition between supply chains. This means that, today, businesses have a preference for engaging with a supply chain where each link in the chain can contribute value through unique collaborative skills to achieve results that neither of the contributors in the supply chain could have achieved on their own account (Spekman et al. 2002, p.41).

De Wit and Meyer (2010 p.356) defined core competencies in the organisation as collective learning. Additionally, it includes involvement, communication and solid commitment from all who work thru firm individual boundaries (Rosenzweig & Roth 2007, p.1312). Core competencies are deemed to be the glue that hold a business together and can be improved upon when both applied and shared internally (Prahalad 1993, p.46; Wieland & Wallenburg 2013, p.302). Firms must preserve and promote core competencies if they wish to obtain as many advantages from them as possible. Moreover, core competencies constitute an essential part of the collaborations that ultimately help in honing a supply chain's value-creating abilities, which are also called supply chain competencies (Wieland & Wallenburg 2013, p.302).

Chow et al. (2008 p. 667) defined supply chain competence as "a portfolio of organizational, managerial, technical, and strategic capabilities and skills developed by enterprises over time". Supply chain competence is the ability of a business to learn, at all levels, enabling it to gain a substantial competitive market advantage as a consequence of existing organisational learning capabilities and the sharing of knowledge (Spekman, Spear & Kamauff 2002). In supply chain management, achieving competitiveness and performance enhancement depends largely on supply chain competence (Derwik & Hellström 2017). Supply chain competency can lead to improvement, both operationally and financially (Aquino & Draper 2008; Bowersox et al. 2000).

This study refers to supply chain competence as the “collective learning of the entire supply chain”. This collective learning results from the strategic collaboration relationships with supply chain partners which created abilities that are valuable, rare, inimitable and non-substitutable by joining the skills of supply chain partners. According to Akber, Muzaffar and Rehman (2011, p. 41) collective learning will help to create a competitive advantage for the supply chain as it involves communication and total commitment of all supply chain partners working across their individual boundaries. Firms that collaborate in a supply chain need to transfer their knowledge within the chain to facilitate collective learning and to sustain any competitive advantage the supply chain may have (Chow et al. 2008; Spekman et al. 2002).

2.4.1 Previous Studies on Supply Chain Competence

Previous research by Das and Teng (2000) places emphasis on having the correct partners in a supply chain to improve the competence of the network. Previous studies have also revealed that supply chain partners must support each other when it comes to sourcing materials and services (Sanchez & Perez 2005). Moreover, Dyer and Singh (1998) stated that learning plays an important role in developing the competence of the supply chain to help with innovation. Supply chain competencies arise from an effective merger between the operating processes of a firm and its supply chain partners (Lambert & Cooper 2000). These competences ultimately enhance the performance of the whole supply chain (Lambert & Cooper 2000).

Chow et al. (2008) studied the relationship between supply chain practices, supply chain concerns, supply chain competences, and organisational performance. The study identified supply chain competence as a variable that mediate the relationship between supply chain practices and overall performance. The study divided supply chain competence into three dimensions: quality and service; operations and distribution as well as design effectiveness. The study also revealed that supply chain competencies have a positive effect on a firm's performance. Additionally, the results of the study indicated that supply chain practices and competencies are intricately connected.

Roldán Bravo, Moreno and Llorens-Montes (2016) showed the influence of power asymmetry and the moderating role of a firm's absorptive and desorptive capacity on improving supply chain competence is based on its orientation to open innovation with its supplier network. The results underscore the influence of both power asymmetry and absorptive capacity when it comes to deriving benefits from a firm's leaning towards open innovation. Additionally, the results reveal that supply chain competence can improve through open innovation.

Kuei et al. (2005) examined the relationship of supply chain quality management to supply chain competence. The study categorised supply chain competence as design capacity and response capacity, plus levels of product quality. The findings of their study showed that supply chain competence, especially the ability to produce a quality product, is positively connected to supplier partnerships. Additionally, the results confirmed that supplier partnership initiatives are closely related to increased quality level of products.

Ritter and Gemu ̈nden (2004), stated that a firm requires technological competence to enable it to add value to products and operational processes. Moreover, firm needs to develop supply chain competence to connect their firm to others in the market to facilitate interaction beyond organizational boundaries. Their study reveals that network competence and technological competence both have a significantly positive impact on the success of a firm's innovation.

Additionally, the results imply that technological strategy of a firm acts as a support for the development of network and technological competencies.

Previous studies have shown that sharing competencies through the building of strategic relationship is crucial in a competitive environment (Spekman, Spear & Kamauff 2002). Sharing of such competencies can be the result of strong knowledge-sharing pathways. Ferrer et al. (2011) identified that supply chain responsiveness, knowledge sharing, and partner flexibility are key aspects for the generation and maintenance of competence in a supply chain. Sharing of competencies can be achieved through the forming of strategic alliances, examples of which include, e.g., joint ventures and standard product development agreements (Bellamy et al. 2014).

Derwik and Hellström (2017), Hsu et al. (2011) and Heide et al. (2008) not only identified key characteristics of supply chain competence, but also spotted a gap in the literature on this construct. They proposed there is a need to study supply chain competence in greater depth as it plays key role, over time, in maintaining a competitive advantage. It is imperative to study supply chain competence as, today, competition is no longer restricted to firms, but also to their supply chain (Green et al. 2014).

While there is ample research on competence at an individual level, there is very little at an inter-organizational level (supply chain competence). Most reviewed publications adopt an ex-post perspective, i.e., they evaluate competences of interest, but fail to analyse how these competences were developed (ex-ante perspective). As supply chain competence results in operational and financial improvement for a business, this lack of understanding means there is a need for in-depth research into ways these competences were developed (Derwik & Hellström 2017). According to

Derwik and Hellström (2017), further research with an ex-ante perspective is needed, i.e., how to develop such competences and how to disseminate them throughout the supply chain. In other word, multiple studies have focused on the results of supply chain competence, but few have focused on pre-existing supply chain competence. Additionally, while the mediation role of supply chain competence has previously been studied (Chow et al. 2008), the role of supply chain competence as a mediator between supply chain collaboration strategies and innovation performance has not been studied. In the literature on supply chain management, competence has been examined from a variety of viewpoints and results remain relatively incoherent. With an incoherent view of supply chain competence a clear need for more research, it is clear the subject requires further research (Derwik & Hellström 2017). The next section will discuss absorptive capacity.

2.5 Absorptive Capacity

Absorptive capacity has been described as the: “ability to recognize the value of new external information, assimilate it and apply it to commercial ends” (Cohen & Levinthal 1990, p. 128). Consequently, the presence of absorptive capacity is essential for an organisation to develop a culture of organisational learning. Organisational learning is key for an organisation to acquire and utilise new knowledge. Alternative descriptions of absorptive capacity have been previously outlined, e.g., Zahra and George (2002) defined absorptive capacity as organisational routines and mechanisms used to acquire, process, transform, and exploit knowledge.

This aligns with the core concept of dynamic capabilities, where absorptive capacity is seen to be an organisation’s dynamic capability. Thus, absorptive capacity can be classed as a first-order dynamic capability. As a first-order dynamic capability enables an organisation to both assimilate knowledge and integrate it within internal processes (Eisenhardt & Martin 2000; Teece et al. 1997), one can consider absorptive capacity to be a dynamic capability.

Treating absorptive capacity as a dynamic capability follows on from multiple research which has classed the treatment of absorptive capacity as being the knowledge stock of an organisation (e.g., Lane et al. 2006; Mariano & Walter 2015; Roberts et al. 2012). This research highlighted that absorptive capacity could generate greater value for a firm if it is seen as a dynamic capability, meaning that absorptive capacity is a form of dynamic capability for an organisation (Senivongse, Bennet & Mariano 2019). Absorptive capacity has also been described as an organisation's fuel for learning and dynamic capacity (Cheng & Lu 2017), supporting the road to achieving optimum operational performance (Patel, Terjesen & Li 2012), and predicting supply chain resilience (Cheng & Lu 2017).

However, connecting absorptive capacity and dynamic capabilities presents conceptual challenges. Wang and Ahmed (2007, p. 35), stated that dynamic capabilities are "a firm's capacity to deploy resources and encapsulate both explicit processes and those tacit elements embedded in the process." Using this this definition, dynamic capabilities are those processes with which capacity is leveraged to perform as a business, i.e., the concept of dynamic capabilities sees business operations as a separate process. However, when taking into account the concept of absorptive capacity, operational process can be seen as a part of the whole, as opposed to a separate process.

Likewise, Winter (2003) pointed out that dynamic capabilities can produce the necessary outcomes in markets with a low-to-medium level of dynamism. Put another way, the reconfiguration process of dynamic capabilities needs time to transform acquired knowledge into actionable results (Senivongse, Bennet & Mariano 2019). One can thus conclude that the dynamic capability of absorptive capacity cannot directly influence a firm's performance or any other aspects that are used to define a firm's success (Senivongse, Bennet & Mariano 2019).

Furthermore, based on dynamic capability theory, a firm's willingness to organize, develop, and restructure intrinsic and extrinsic tools or competencies is a method for dealing with challenging conditions (Eisenhardt & Martin 2000). Absorptive capacity enables a business to become more dynamic through encouraging organizational learning (Mowery, Oxley & Silverman 1996). The nature of absorptive capacity is adaptable as it can help businesses to achieve a strategic advantage through the constant acquisition of information, updating its knowledge base, and utilising new knowledge (Zahra & George 2002). Teece, Pisano and Shuen (1997) contend that a firm holds and amasses advantageous expertise when managing internal and external capital. Thus, through the analysis of internal reactions to environmental shifts, this theory places an emphasis on the complex nature of a resource-based opinion (Wang, Klein & Jiang 2007; Winter 2003). Additionally, a recent analysis of the concept of absorptive capacity showed that one of the principal areas of research in absorptive capacity related to dynamic capability (see Apriliyanti & Alon, 2016).

In at least two respects, absorptive capacity can lead to a firm's overall innovative success. For a start, absorptive ability allows a firm to collate external knowledge, which it can then combine with its existing knowledge to drive innovation (Cohen & Levinthal 1990). In such a context, absorptive capacity helps firms to be more creatively competitive through the ability to process valuable external information. As knowledge is rarely efficiently disseminated throughout an organisation (Hargadon & Sutton 1997), insights or knowledge from one department used to influence another can produce better results through information sharing (Cohen & Levinthal 1990). By acting as a catalyst for information transfer, absorptive capacity can improve a firm's innovative performance through cross-organizational innovation activities (Kostopoulos et al. 2011).

Gölgeci and Kuivalainen (2020) outline that absorptive capacity acts as a boundary that spans dynamic capability. The ability to span boundaries creates a link between businesses and the external environment (Williams 2002). Business activities that span organizational boundaries are supported through the enabling of productive interactions and partnerships across business ecosystems (Zhang, Viswanathan & Henke 2011). By interpreting and transmitting knowledge, boundary-spanning capabilities allow fostering interaction between the various parties and thus coping with knowledge heterogeneity. Thus, boundary-spanning technologies are used to develop firm-level assets by allowing efficient communications that facilitate larger and more successful connections in supply chains, thereby fostering confidence between cooperating companies. Firms continually depend on the expertise of their supply chain collaborators to provide superior value to consumers (Saenz, Revilla, & Knoppen 2014). This transition involves absorptive capacity, which relates to the routines and processes through which companies obtain, assimilate, turn, and leverage knowledge located beyond the firm's organizational borders in order to generate a complex organizational capability (Zahra & George 2002).

Beyond this, businesses in the context of the supply chain have a greater capacity of absorption, are purported to be the optimally equipped to cope with external risks using entrepreneurial mechanisms, and to mitigate the impact of any disruption (Van Doorn et al. 2017). To this end, absorptive capacity facilitates the rapid assessment of and reaction to adverse environmental shifts, thus promoting and enabling positive progress (Yaqun et al. 2014). Thus, the role of absorptive capacity can be seen to be that of an enabler (i.e., a moderator).

2.5.1 Previous Studies on Absorptive Capacity

In the context of the supply chain, multiple studies have identified absorptive capacity as a moderating construct. For instance, D'Angeloa, Ganotakis and Love (2020) discovered that absorptive capacity plays a positive role as a moderator on the relationship between organisational innovation performance and rapid export growth. Furthermore, Zhu, Zhao and Abbas (2020) identified the positive moderating role of absorptive capacity on the relationship between innovation performance and levels of investment in R&D. In the pharmaceutical industry context, absorptive capacity has been identified to play a moderating role on the relationship between strategic alliances, e.g., acquisitions and mergers, on innovation performance (Fernald 2017).

Recent studies show that absorptive capacity is directly connected to innovation performance (Harris et al. 2020, Zou et al. 2018). To establish the effects of absorptive capacity on innovation performance, Harris et al. (2020 p. 1-7) performed a cross-country analysis, focusing on the construction of an enterprise-level estimate of absorptive capacity levels throughout Europe. In addition, their study aimed to examine absorptive capacity variations related to R&D and innovation throughout multiple countries (Harris et al. 2020, p.1-7). Consequently, the research used data from the Community Innovation Survey which provided ample information on how innovation manifests itself in multiple enterprises across Europe. Results from the survey reveal that levels of absorptive capacity vary considerably across all European countries (Harris et al. 2020, p. 1-7). Higher enterprise innovation levels were found in Germany as a consequence of heightened use of absorptive capacity. However, low absorptive capacity was found in businesses in Eastern Europe, especially Italy, resulting in low levels of enterprise innovation (Harris et al. 2020, pp. 1-7). The study showed that absorptive capacity positively affects R&D strategies used by various firms. Consequently, the focus of governments should be on enhancing absorptive capacity levels, thus increasing external knowledge value which, in turn, can be utilized by multiple enterprises (Harris et al. 2020, pp. 1-7). The study highlighted a research gap on the challenges experienced by SMEs in Croatia, Norway, and Portugal in the use of absorptive capacity to encourage innovative performance. Harris et al. (2020, pp. 1-7) created a connection between absorptive capacity and the theory of dynamic capability. Specifically, the research clarified how knowledge can be used as an important asset in a firm to foster innovative performance.

Zou et al. (2018, pp. 87-121) performed a meta-analysis of absorptive capacity to identify its role in the fostering of organizational innovation. An empirical analysis was carried out to establish what were current insights into how absorptive capacity has been used to foster innovative performance. Zou et al. (2018, pp. 87-121) examined over 241 studies to establish how absorptive capacity can be a strong predictor of innovation. This study evaluated the connection between knowledge transfer and the financial aspects of a firm. A theoretical discourse analysis revealed that absorptive capacity is key for enabling firms to seek out new and valuable information that can foster innovation (Zou et al. 2018, pp. 87-121). The study's results encouraged the authors to re-examine existing assumptions on how innovation is fostered by absorptive capacity. Adopting a meta-analysis strategy established a correlation between firm size and absorptive capacity role. Financial capacity, knowledge transfer, and structural modelling equations were studied (Zou et al. 2018, pp. 87-121). The research concluded that it leads to the identification of new and valuable information absorptive capacity which was essential for fostering organizational innovation. Zou et al. (2018, pp. 87-121) established a connection between dynamic capability theory and absorptive capacity. Zou et al. (2018, pp. 87-121), analysed how an organization sourced valuable knowledge, analysed it, and applied it to foster innovative performance. As in the theory of dynamic capability, this research sees knowledge as a vital asset for encouraging innovative performance.

However, certain research has identified that the results are inconclusive with regard to absorptive capacity and the model of the supply chain partnership (Ishihara & Zolkiewski 2017; Roldán Bravo et al. 2020; Wagner 2012; Zacharia, Nix & Lusch 2011). Wagner (2012), revealed that supplier-specific absorptive capacity has no moderating effect on the relationship between supplier integration in FFE and NPD project performance. Zacharia et al. (2011), suggest that absorptive capacity is a necessary but insufficient requirement for effective collaboration. Moreover, Roldán Bravo et al. 2020, recently discovered that there was no statistically significant evidence on the moderating effect of an organisation's absorptive capacity. This study further extends the current understanding that absorptive capacity is an essential yet insufficient dynamic capability for effective knowledge transfer. Ishihara and Zolkiewski (2017) explained that "absorptive capacity may lack value for the receiver of knowledge when the sender's disseminative capacity is low". Thus, it is not enough for the recipient of information to have strong absorptive capacity if the disseminator of information cannot do so appropriately.

In the supply chain context, while the role and importance of absorptive capacity in driving innovation performance (Harris et al. 2020; Zou et al. 2018; Zhu, Zhao & Abbas 2020), in the pharmaceutical context (Fernald 2017), results are still inconclusive on the subject and there is very limited research examining the moderating role of absorptive capacity in the context of supply chain collaboration strategies.

2.6 Summary

This chapter elaborated current literature on strategic relationship with supply partner, supplier involvement in NPD, and how it links to absorptive capacity, supply chain competence, and innovation performance. These concepts can be studied in the light of the theory of dynamic capabilities, which is the core theory that directs the present research. The forthcoming chapter aims to elucidate the relationships among the above-mentioned concepts.

3 Chapter Three: Conceptual Framework

This chapter first discusses the conceptual framework that provides theoretical support for the research presented in this thesis. Thereafter, this chapter develops research hypotheses from the theory and previous literature that establishes the relationship between strategic relationship with supply chain partner and innovation performance, as well as highlighting the impact that supplier involvement in NPD has on innovation performance and how supply chain competence plays the role of a mediator in this relationship. Finally, the author will discuss the moderation role of absorptive capacity on the relationship between supply chain collaboration strategies and innovation performance.

3.1 Conceptual Framework of the Present Research

The present research is substantially supported by the theory of dynamic capabilities, as highlighted in the previous chapter. Notably, the theory of dynamic capabilities finds its roots in the theory of the growth of the firm (Augier & Teece 2007; Lockett & Wright 2005; Pitelis 2007), which was developed by Edith Penrose (1959). As per the theory of dynamic capabilities, every firm has (or creates) certain capabilities that it can leverage to create a substantial competitive advantage. In order generate this advantage, firms must create and adopt path dependencies and organisational routines since this can help them adjust to a highly dynamic external environment (Teece & Pisano 1994). Thus, path-dependent resources, in the realm of dynamic capabilities, guide an organisation’s growth, ensuring that a sustainable competitive advantage is maintained (Prahalad & Hamel 1990).

Zimmermann et al. (2016) identified integration for both NPD and strategic relationship with supply chain partner as supply chain strategies/approaches that result in innovation performance. This is because both supplier involvement in NPD and strategic relationship with supply chain partner are dynamic capabilities linked with innovation performance (Eisenhardt & Martin 2000; Teece et al. 1997). Indeed, innovation is an indispensable part of the success and cutting edge of an organisation which often results in improved financial performance and creates a competitive advantage (Danneels 2002; Sharma & Lacey 2004). The successful conception, implementation, and management of an innovation depend upon a firm's operational capabilities (Brown & Eisenhardt 1995; Danneels 2002; Galunic & Rodan 1998; Simpson, Siguaw & Enz 2006; Teece 1986; Verona 1999). Therefore, supplier involvement in NPD and strategic relationship with supply chain partner can give a firm the capabilities it needs to effectively manage and leverage innovation performance.

In addition, based on Zimmerman et al.'s (2016) theoretical umbrella, suppliers give knowledge and take an active role in the development of new goods, procedures, and solutions. This strategy demands businesses to examine the capabilities of suppliers to create new goods when selecting suppliers. Supplier integration into the new product development process is the most typical kind of supply chain collaboration. In addition, based on Zimmerman et al. (2016), it can also be stated that collaboration amongst supply chain participants may be seen as a step forward in terms of NPD integration. Sharing of knowledge across firms is a successful method for enhanced efficiency, particularly in the area of innovation and new product development. Formalization and continuous contact among enterprises, as well as information exchange, are critical factors for collaborative value creation, which can then enhance innovation performance.

Additionally, according to the analysis carried out by Zimmermann et al. (2016) absorptive capacity of the firm is identified as one of the proposed factors that tend to improve innovation performance. Firms that can share and transfer their learning both internally and externally can achieve sustainable performance improvements throughout their business operations (Cohen & Levinthal 1990). In fact, collaboration between firms encourages those firms to maintain a competitive advantage. Alternatively, sharing knowledge internally can help firm build new strategies that specifically leverage this internal information-sharing system. This means that absorptive capacity, which is the ability of a firm to learn and to apply its learning, is also a dynamic capability (Cohen & Levinthal 1990).

In the context of the dynamic capabilities theory, supply chain competence represents the collective learning skills of a firm because learning is necessary for that firm to maintain a competitive advantage and respond to uncertainties in the market (Chow et al. 2008). Chow et al. (2008) in his study examined the relationship between supply chain competence and overall performance and found that supply chain competence positively affects overall performance. Several studies have also explored the relationship between competences and innovation, discovering that the core competences of a firm increase its capability to innovate (Zirger & Maidique 1990).

Finally, innovation is among the key factors driving renewal and growth in a firm, which has been shown to contribute to a competitive advantage. According to Bashir and Verma (2017, p.7) in the modern business environment, innovation performance is considered as a new competitive advantage. Over 85% of business executives across the world acknowledge that innovation is critical to the success and long-term growth of their organizations (Bock, 2021). Indeed, innovation is the new competitive advantage. Several old and recent studies and commentaries by scholars in the field attest to this idea. Musselwhite (1990) had posited that time-based innovation was going to be the new competitive advantage in the 1990s. His idea was directed at manufacturers, who, he believed, needed to respond promptly to market demands by devising innovative strategies that could reduce the idea-to-market product development time (Musselwhite, 1990).

Bashir and Verma (2017) propose that business model innovation – or innovation in the manner in which organizations make profits/capture value – is the new competitive advantage. They suggest that globalization, rapid evolution of technology and major shifts in market make business model innovation the only sustainable competitive advantage. This is because while innovation in products or services can be easily imitated by competitors, replicating a new business model is difficult (Bashir & Verma, 2017).

More recently, Lee and Yoo (2019) championed open innovation – or innovation that involves collaboration with external knowledge sources – as the new competitive advantage. Open innovation allows organizations to respond quickly to the evolving external environment by transforming crucial market-related information (obtained from internal and external sources of knowledge) into a resource (Lee & Yoo, 2019). Similarly, in the context of the highly competitive mobile telecommunication industry in Ghana, Ofori et al. (2015) found that innovation, aided by knowledge sharing, is the new competitive advantage.

Supporting the ideas of Musselwhite (1990), Bashir and Verma (2017) and Lee and Yoo (2019), Bock (2021) suggests that innovation should not be limited to product innovation, but should be extended to customer experience, supply chain, organizational structure, networking, etc. Only organizations that innovate in all these aspects of their value chain can gain substantial competitive advantage over their competitors (Bock, 2021). Thus, over decades, innovation has been the new competitive advantage, whether it happens in manufacturing strategy, transformability of knowledge, or at other levels of an organization's value chain.

The present research employs the theory of dynamic capabilities to investigate the strategic relationship with supply chain partner, supplier involvement in NPD, innovation performance, supply chain competence, and absorptive capacity. Several previous studies in the field of strategic management have also focused on developing models of dynamic capabilities in the context of various strategic goals of firms, such as complex environments, firm performance, entrepreneurship, innovation, new product development and product innovation, and market performance (Borch 2004; Borch & Madsen 2007; Ge & Dong 2009; Liao & Kickul 2009; Pavlou & Sawy 2006; Poulis & Jackson 2006; Yalcinka, Calantone & Griffith 2007; Zot 2000).

Dynamic capabilities can provide extensive learning to the firm, thereby allowing it to develop innovative solutions and hence improve its innovation performance (Liao & Kickul 2009; Borch & Madsen 2007). The theory of dynamic capabilities has also been used to develop supply chain collaboration strategies such as supplier involvement in NPD and strategic relationship with supply chain partner. Such supply chain collaboration strategies are considered as dynamic capabilities since they are internal capabilities and routines – an alliance function that can provide significant benefits to the firm. Indeed, supply chain collaboration strategies are higher-order dynamic capabilities because developing them will expose the firm to novel learning which the firm can then assimilate to transform its resources by creating, reconfiguring, and integrating competences (Eisenhardt & Martin 2000; Teece et al. 1997).

Theoretically, we view supplier involvement in NPD and strategic relationship with supply chain partner as a higher-order dynamic capability. The main elements of a dynamic capability are: sensing; learning; integrating; and coordinating (Pavlou & Sawy 2011). In terms of supplier involvement in NPD and strategic relationship with supply chain partner both strategies provides the firm with strategically thoughtful way and a wider view for identifying, understanding, and responding to opportunities in the uncertain dynamic environment (*sensing*). This relationship and integration with supply chain partners feeds a continual stream of new knowledge into the principal firm, which it can use to strategically revamp existing capabilities and develop new ones (*learning*). Close connections among supply chain partners help to develop the creation of collective learning and a shared understanding that enhance the strategic development of improved processes throughout the supply chain (*integration*). Strategic relationship with supply chain partner and supplier involvement in NPD also generates the ability of its partner firms to identify interactions among their activities, tasks and resources that lead to improvement of the synchronization between partners and expansion of the creation of competences (*coordination*).

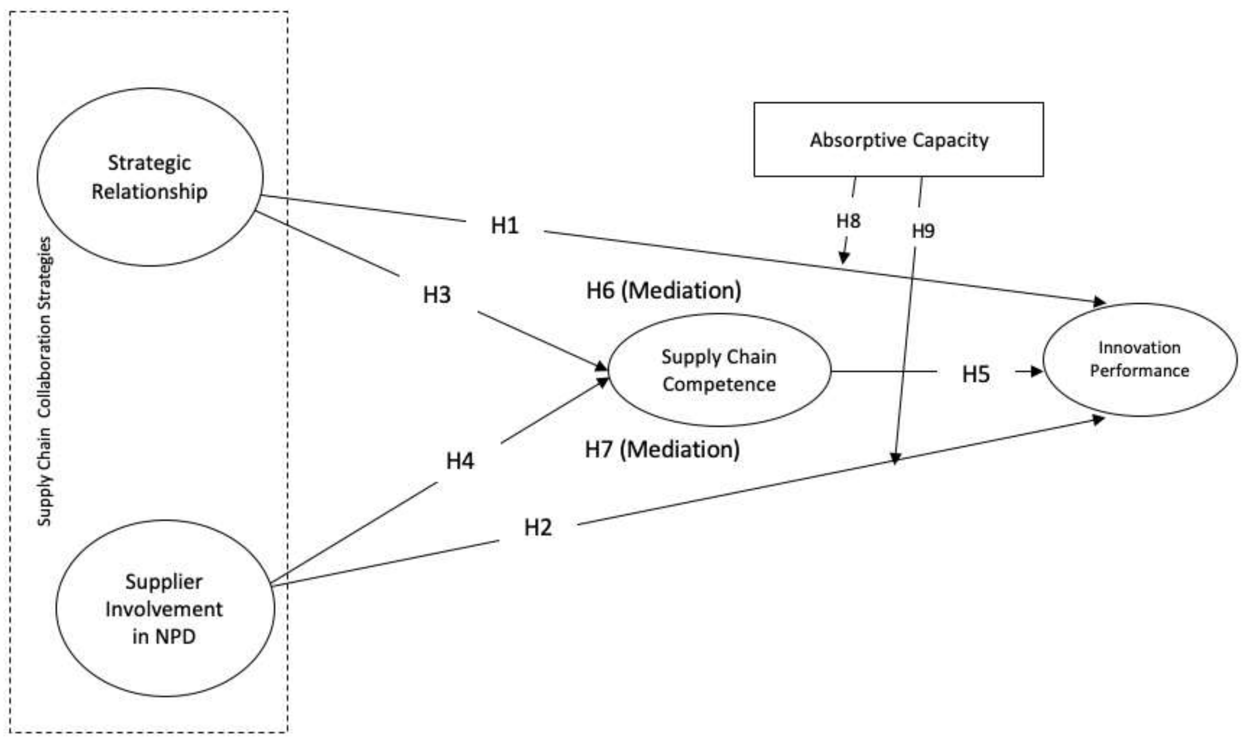


Figure 3.1: Conceptual model

3.2 Strategic Relationship and Innovation Performance

Building strategic relationship with supply chain partner opens up avenues for innovation since such relationships require those firms involved to collaborate, exchange expertise, share data and resources, and coordinate their activities (Francesco, Luciano & Silvia 2015; Kumar, Subramanian & Arputham 2017; Zhou et al. 2017). Thus, strategic relationship is related to innovation performance and encourages the supply chain firm to engage in greater innovation thereby increasing the extent of innovation (Nielsen & Nielsen, 2009). This relationship between innovation performance and strategic relationship has been identified by past research whereby studies have confirmed this interdependence of strategic relationship and supply chain innovation (Avison et al. 2004; Cui et al. 2018; Oke et al. 2013; Yang & Hsu 2010). For example, Yang and

Hsu (2010) found that innovation rate increased significantly with higher supplier collaboration. Therefore, strategic relationship with supply chain partner can leads to improved innovation performance. Moreover, exchange of relevant knowledge with and among supply chain partners can facilitate the collaborative use of individual resources and capabilities to develop new products (Cho, Kim & Jeong 2017), which can lead to increased innovation performance outcomes. Indeed, Adebanjo, Teh and Ahmed (2017) found that building relationships between supply chain partners as new dynamic capabilities helps enhance production efficiency, which has further implications on innovation performance.

Another manner in which strategic relationship and innovation performance are linked is that if all supply chain stakeholders participate in the decision-making process, they will be able to better understand their responsibilities and positions in the supply chain relationship (Porter & Birdi 2018). This, aided by knowledge sharing, will help engender greater trust and thus the buyer-supplier collaboration will lead to bigger investments in the innovation process (Corsten, Gruen & Peyinghaus 2011). At the same time, it is important to ensure that collaborations with supply chain partners create higher co-created value than those with competitors (Nieto & Santamaría 2007).

Other studies have found that strategic alignment is closely related to some of the critical determinants of the success of innovation (Acur, Kandemir & Boer 2012; Burn & Szeto 2000; Kearns & Lederer 2003). Examples of such success determinants include supply chain operational capabilities and corporate competitive capabilities, which can significantly enhance a firm's performance. Another study by Bergeron, Raymond, and Rivard (2004) provided support for this view by investigating the ideal relationship between strategic alignment and innovation performance. This study revealed that the firm structures, business strategies, and IT operations' strategies of low-performing firms had conflicting patterns in their strategic alignment.

Thus, building strategic relationship with supply chain partner can generate an innovation-driven competitive advantage through a firm's internal competencies and processes (Kraaijenbrink, Spender & Groen 2010). At the same time, a firm's internal competencies and processes are themselves dependent on the relationships between supply chain partners and the tools and processes used to assess these relationships (Eggers & Kaplan 2013; Felin et al. 2012). These processes, also known as micro-processes or micro-practices, allow firms to use their competencies and share their resources with their supply chain partners thereby increasing innovation performance of the firm (Kraaijenbrink et al. 2010; Vesalainen & Hakala 2014; Wang & Rajagopalan 2015). Once again, resource-sharing can improve a firm's performance outcomes such as innovation performance (Kraaijenbrink et al. 2010). Recent studies, such as the one by Yang and Lin (2020), have further confirmed that the relationships between supply chain partners significantly affect innovation performance.

It is vital for enterprises to form strategic relationships in complex and dynamic settings since local search processes may fail to uncover the optimal solution to a problem, which may hamper innovation performance of a firm (Sorenson & Fleming 2004). According to Leonard-Barton (1992), established skills may become fundamental rigidities in complex situations, preventing businesses from altering and adapting to external demands. It has been argued by Levinthal and March (1993) that past experience might be a "bad teacher," contributing to a narrow view of what can be learned and an inability to adapt to developments in the outside world. Having access to a wide variety of information sources is essential to a company's ability to innovate (Sorenson &

Fleming 2004). Firms have a propensity to incorporate common information (Levinthal & March, 1993), which makes it more probable that they will undertake small, incremental innovations close to their current trajectory. On the other hand, exploring with innovative and varied factors might enable the organisation to produce new and various innovation results (Ahuja & Lampert, 2001). Thus, innovating is easier when there is good strategic relationship with a supply chain partner. Such connections need the cooperation of the parties involved, as well as the sharing of knowledge, data, and resources. Strategic alignment has been linked to a number of important innovation success factors, according to research. It is possible to enhance innovation performance by forming strategic alliances with other companies in the supply chain. A company's capacity to innovate depends on having access to a broad range of information sources that can only be obtained through forming strategic relationships. Firms are more likely to implement incremental innovations if they have a predisposition to integrate common knowledge. Thus, to summarise the above discussion, forming strategic relationship with supply chain partner improves a firm's innovation performance. Based on this idea, the following hypothesis has been developed:

Hypothesis 1: Strategic relationship with supply chain partner is positively related to innovation performance

3.3 Supplier Involvement in NPD and Innovation Performance

For supplier involvement in NPD to be fruitful, there must be an adequate exchange of information and the provision of joint decision-making throughout the supply chain (Petersen et al. 2005). Thus, suppliers have a significantly larger role to play in NPD than previously observed and reported (Dröge, Jayaram & Vickery 2000). A close collaboration between suppliers means better knowledge sharing and enhanced corporate learning (Dyer & Nobeoka 2000; Sobrero & Roberts 2001). According to Yeniyurt et al. (2013), the timely and extensive involvement of suppliers in new product development improves the NPD process by ensuring increased effectiveness and efficiency.

Supplier involvement in NPD allows product development teams to communicate readily with the suppliers so as to collaboratively develop innovative products and technologies. Improved communication with suppliers provides NPD teams the benefit of procuring high-quality raw materials as soon as manufacturing begins (Darawong 2019). Koufteros, Vonderembse and Jayaram (2005) noted that partnerships with suppliers led to useful innovations, better product quality, and higher project efficiency. They also found that an integration phase in such collaborations develops new experts who can increase competence by reducing the production lifecycle and ensuring timely release of new products.

Various studies support the importance of supplier involvement in NPD through innovation performance (Zimmermann et al. 2016; Luzzini et al. 2015). According to Zimmermann et al. (2016), the supply chain provides a network in which suppliers can provide products and services to the end customers, thus making many firms reliant on suppliers to acquire innovative product input. Literature provided by Luzzini et al. (2015) emphasizes the importance of supplier involvement in NPD and innovation performance through collaboration and strategic sourcing.

Current literature supports that dynamic capabilities emphasize that innovation in NPD requires timely and adequate involvement of suppliers and other stakeholders. Supplier involvement in NPD has higher-order dynamic capabilities that help product enhancement (Cheng & Krumwiede 2018).

Dynamic capacities entail a firm's ability to sense the need for innovation, learn the various approaches needed to enhance innovation, integrate the new findings in the betterment of the product or service, and coordinate through various stakeholders and departments. This relationship between new product development and innovation performance has not been comprehensively studied in the context of the pharmaceutical supply chain. In tandem with the desire to integrate the processes of multiple links in the supply chain, prior research has advocated for having an early and extensive supplier involvement, leading to a faster development process (Füller et al. 2006; Hoyer et al. 2010).

The theory of dynamic capabilities is used to understand the influence of supplier involvement in NPD on innovation performance. Previous studies state that the four dynamic capabilities, sensing, learning, integration, and coordination, are necessary for innovation performance through supplier involvement in NPD. Firms and other stakeholders, including suppliers, need the capability to learn quickly and ensure innovation for NPD (Yeniyurt et al. 2013, p.301). Previous studies show that the firm needs to *seize* and *sense* opportunities and threats, respectively (Bashir & Verma, 2017, p.12). The firm then needs to maintain competitiveness via enhancing, protecting, combining, and configuring the businesses' tangible and intangible assets. *Learning* entails shared codes of coordination and communication search procedures. In involving suppliers in the NPD process, the firm gathers knowledge that helps develop new ideas for NPD. Integration with the suppliers creates a new form of learning that helps the firm recognize the dysfunctional elements and aids in the *integration* of these innovations in the development of products that suit the customers' needs (Cheng & Krumwiede, 2018). Finally, *coordination* between the firm and the suppliers helps in producing and supplying new products to customers.

Since corporate settings have gotten more aggressive and dynamic, organizations have recently turned to external sources for innovation that would help them maintain their profitability (e.g., Fuchs and Schreier 2011; Knudsen 2007; Lau et al. 2010). These agreements are significant in practise since few organisations, especially those in production, acquire the breadth of competences or the manpower required to manufacture all components that form their final products. Indeed, evidence indicates that businesses with a broad network of external sources of information are more inventive than those with a limited or non-existent relationship with other parties (Bjork and Magnusson 2009). As a result, a firm's capacity to foster an innovation ecosystem (i.e., incorporating suppliers into the process of NPD) may be a crucial function that significantly impacts a firm's innovation capability. Earlier research indicates that trusting suppliers and collaborating with them in the product development stage is a significant predictor of greater innovation performance (Henke and Zhang, 2010). Furthermore, several studies have shown clear strong evidence and broad engagement of providers in buyers' NPD increases buyers' innovation performance as well as enhances the quality, efficiency, affordability, and timeliness (van Echtelt et al. 2008; Ragatz et al. 2002). Thus, suppliers play a much larger role in NPD than has previously been seen and acknowledged. NPD teams gain from the advantage of acquiring high-quality raw materials immediately upon production commencement. Product development teams can interact easily with suppliers in order to build novel goods collectively. Firms and other stakeholders must be able to adapt fast and guarantee NPD innovation. By incorporating suppliers in the NPD process, the business gains information that aids in the development of new NPD concepts. Integration with suppliers establishes a new mode of learning, assisting the business in identifying problematic parts and incorporating these innovations into goods that meet the demands of the clients. Therefore, supplier involvement in NPD as a dynamic capability improves the innovation performance of a firm. Based on this idea, the following hypothesis has been developed:

Hypothesis 2: Supplier involvement in NPD is positively related to innovation performance.

3.4 Mediating Role of Supply Chain Competence

Supply chain competence in the current study define as the collective learning or knowledge of the supply chain. This collective learning is facilitated by the implementation of supply chain collaboration strategies, which create abilities and skills that are unique and inimitable by bringing together the core competencies of the supply chain partners. Collective learning thus provides a firm with a competitive advantage as well as the ability to develop new products and services. When firms focus on their core competencies, they can gain a competitive advantage (Srivastava 2005, p.51). De Wit and Meyer (2010) define core competencies as a firm’s collective learning, particularly its ability to coordinate and integrate diverse production technologies and skills. This ability can only be honed by those who can recognise and act upon the opportunities to merge their expertise with those of others in innovative ways (De Wit & Meyer 2010). In the context of the theory of dynamic capabilities, this means firms must combine and reorganise their asset positions to build supply chain competence (Ambrosini & Bowma 2009).

3.4.1 Strategic Relationship and Supply Chain Competence

Strategic relationship with supply chain partner is a dynamic capability that can lead to tremendous success in a firm’s supply chain activities when optimally managed. As indicated in the literature, a firm needs to build strong, collaborative, and trustworthy relationships with suppliers for competency (Spekman et al. 2002). The theory of dynamic capabilities can help understand the impact of strategic relationship with supply chain partner on supply chain competence. Various studies have posited that competences are derived from dynamic capabilities (Prahalad & Hamel 1990; Zhang, Vonderembse & Lim 2002). ‘Capability’ and ‘competence’ are two distinct, slightly different terms that broadly refer to skill and ability. ‘Capability’ refers to the state of having the capacity to do a task. In this state, the entity with the ‘capability’ can potentially improve its skills to perform that task. Capabilities can include value chain integration, product development, design and operations, marketing and customer service, etc. (Miller, Eisenstat & Foote 2002). Meanwhile, ‘competence’ takes the meaning of skill one step further than ‘capability’ – it is the degree of skill in the entity’s performance of a task. Firms can develop capabilities by using those tangible and intangible resources that help them generate value (Amit & Schoemaker 1993; Dierickx, Cool & Barney 1989; Grant 1991; Teece, Pisano & Shuen 1997; Miller et al. 2002). Moreover, a firm with capabilities can expand and improve its skills through practice and learning. Thus, capability is the prerequisite for competence. In other words, competence is derived when capabilities are applied.

Previous studies have revealed various benefits of strategic relationship with supply chain partner. These benefits include improved innovation, performance outcomes, resource reconfiguration, and knowledge absorption (Battor & Battor 2010; Ritter & Gemünden 2003; Tzokas et al. 2015). Strategic relationship helps firms in amassing external knowledge (Drewniak & Karaszewski 2020; Hagedoorn 1993; Hamel 1991; Inkpen 2000; Inkpen & Dinur 1998; Yang et al. 2015). They further provide firms access to services that would otherwise be beyond their limits (Das & Teng 2000). Thus, the ability to efficiently build and modify strategic relationship with supply chain partner is a dynamic capability (Kale et al. 2002). Specifically, strategic relationship with supply chain partner serves as an important example of a first-order dynamic capability (Anand, Oriani & Vassolo 2010; Helfat & Winter 2011; Schilke & Goerzen 2010). Building strategic relationship with supply chain partner allows firms to alter their inter-organisational network relationships through partnership in response to a changing external environment (Hoffmann 2007). This dynamic capability includes skills such as identifying beneficial collaboration opportunities, designing and developing collaborations, and assimilating and integrating collective learning (Kale & Singh 2007). Building strategic relationship with supply chain partner allows firms to pursue new business opportunities with partners (Hitt et al. 2000). A firm should structure its partnerships in a manner that allows it to learn new capabilities from its partners as well as to receive external capital (Hoffmann 2007).

The benefit of strategic connections with partners has been recognised as firms develop the ability to manage and optimise strategic partnerships (e.g., Palmatier, Miao, & Fang, 2007; Felzensztein, Stringer, Benson-Rea, & Freeman, 2014; Gunasekaran, Lai, & Cheng, 2008; Swan et al., 2007). So much emphasis has been paid to the importance of developing strategic connections because of the importance of forming alliances, collaborations, and cooperation via value chain partners (Niesten & Jolink, 2015; Lambe & Spekman, 2002; Ritter & Gemünden, 2004). Additionally, companies' desire to gain knowledge and engage in educational opportunities adds to the expansion of value co-creation, greater productivity, and innovative outcomes (Sluyts, Matthyssens, Martens, & Streukens, 2011).

However, one of the primary gaps is a limited focus placed on evaluating the supply chain competence directly. What is clearly missing in past research is the fact that little to no studies have focused on establishing the relationship between strategic relationship with supply partner and supply chain competence in the context of pharmaceutical firms despite the relative importance of strategic relationship with supply chain partner in the industry (Mullin 2014; Wang & Jie 2019; Yoon et al. 2018).

With strategic supply chain partners, customers' happiness and suppliers' performance have been shown to be improved and profit margins increased, as has responsiveness and quality of the product or service being given (Johnson et al. 2004; Swan et al. 2007). Increased R&D and product innovation may also be achieved via strategic partnerships with supply chain partners, as well as increased customer value (Battor & Battor 2010; Lages et al. 2009; Berghman et al. 2006). Consequently, the development of strategic alliances with supply chain partners will lead to strategic alliance capacity, which underpins the dynamic capabilities viewpoint, will lead to the creation of the ability to manage supply chain processes.

Thus, in conclusion, when properly managed, a company's supply chain operations may benefit greatly from strategic relationships with supply chain partners. Companies need to create strong, collaborative and trustworthy relationships with their suppliers in order to be successful. Firms might change their inter-organizational network ties by establishing a strategic partnership with a supply chain partner. This includes the ability to find mutually advantageous collaborations. Firms need to organise their collaborations such that they may learn new skills from their partners, which can subsequently lead to greater competence. It is impossible to overstate the value of strategic supply chain relationships. It has been shown that these collaborations boost customer satisfaction and supplier performance. As part of supply chain competency, these relationships may also lead to improved R&D and product innovation, as well as enhanced consumer value. Therefore, the present study proposes that building strategic relationship with supply chain partner allows firms to acquire knowledge from external sources, pursue emerging opportunities, and modify their products or procedures to address new demands. Overall, it helps the supply chain to achieve competence. Supply chain competence is a critical requirement in the pharmaceutical industry given the significance of the industry as well as the complexity of its production and distribution processes (Friend, Swanick & Arlington 2011). Based on the above discussion, the following hypothesis has been developed:

Hypothesis 3: Strategic relationship with supply chain partner is positively related to supply chain competence.

3.4.2 Supplier Involvement in NPD and Supply Chain Competence

New product development is a resource-intensive, complicated and unpredictable process whose outcomes may or may not match with a firm's anticipation (Liang et al. 2014). To ensure the success of NPD, it is important for firm to engage in a relationship with suppliers and possess the capability to make the most of the external resources (La Rocca et al. 2016; Menguc, Auh & Ozanne 2010; Mu et al. 2017; Tsai 2009). Several studies have shown that the degree of supplier involvement in NPD is directly correlated with the number of advantages created for the firm as well as its customers (Bakhshi & McVittie 2009; Chen & Stewart 2010; Kang et al. 2020; Nagashima et al. 2015; Lin, Chen & Yeh 2014; Tan, Kannan & Handfield 1998; Frohlich & Westbrook 2001; Scholten & Schilder 2015; Valkokari, Paasi & Rantala 2012).

Supplier involvement in NPD, like strategic relationship with supply chain partner, is a dynamic capability since it enables the collection and assimilation of learning from suppliers to improve competence (Krishnan & Ulrich 2001). Supplier involvement in NPD helps firms to build an integrating capability (Pavlou & Sawy 2011). Integrating capability is the ability of the firm to integrate new knowledge with previous knowledge of the firm's business operations (Pavlou & Sawy 2011). Successful NPD requires all participating firms to integrate their knowledge and experience acquired from both internal and external sources. Internal sources of knowledge could be R&D, marketing, or production within the firm, while external sources come from the relationship with suppliers in the supply chain. By integrating collective knowledge, the participating firms enhance their shared understanding of business processes and market forces. In fact, previous study has shown that integrating existing knowledge by utilising it to perform tasks can improve the competence, process efficiency, product quality and overall efficiency of a firm (Sherman, Berkowitz & Souder 2005). Integrating knowledge obtained from external sources prepares a firm to efficiently handle complex, ambiguous, and competitive external environments (Darawong 2019).

Supply chain competence is explained using the dynamic capabilities theory. According to Pavlou and El Sawy 2011 firms can face challenges using dynamic capabilities which comprise four components: (i) The ability to sense the opportunity in the market; (ii) The ability of to learn quickly; (iii) The ability to build new core assets and skills through the integration of capabilities and new technology into the firm's existing processes; and lastly, (iv) The ability of coordination and transformation of existing skills and core assets (Pavlou & El Sawy 2011). Dynamic capabilities theory suggest that firms who involve their suppliers in NPD processes can learn collectively: learning, requires employees and managers in the pharmaceutical industry to reorganize their routines to promote interactions that lead to successful solutions to particular problems, to recognize and avoid dysfunctional activity and strategic blind spots, and to make appropriate use of alliances and acquisitions to bring new core assets and skills into the firm from external sources such as the supply chain partners.

Buyers incorporate suppliers into their NPD initiatives not just to get access to their skills and expertise (Parker, Zsidisin & Ragatz 2008), but to surmount cost constraints and reduce risk that comes with NPD projects (Song & Di Benedetto 2008; Wagner & Hoegl 2006). Engaging suppliers into NPD initiatives requires them to provide content and engage in decision-making throughout the introduction of unique goods, techniques, or activities (Petersen et al. 2005), all of which has the potential to improve supply chain competency. Also, the interactive nature of buyer-supplier relationships adds to the effective utilization of vendors' expertise in order to create goods with cheap production costs and excellent competence (Primo & Amundson 2002). When suppliers are consulted early on in the design process, they are more likely to dedicate their best capabilities and resources to the project, resulting in an increase in overall supply chain competency.

The present study proposes that the pharmaceutical industry could develop supply chain competence by involving its suppliers in NPD processes. Supplier involvement in NPD could involve a collective learning in a better communication system that allows rapid transmission of information from the primary firm to other members of the supply chain. Ultimately, supplier involvement in NPD allows all the firms in the supply chain to develop collective learning, identify customer demand in advance, respond to this demand in a timely manner, and ultimately develop and deliver high-quality products. To summarise the above discussion, supplier involvement in NPD allows firms to build supply chain competence. Upon this idea, the following hypothesis has been developed:

Hypothesis 4: Supplier Involvement in NPD is positively related to supply chain competence

3.4.3 Supply Chain Competence and Innovation Performance

As stated in previous literature, supply chain competence is the primary determinant of a competitive edge (Spekman et al. 2002). It is important for firms to build competence so as to gain as many benefits as possible from the resources available to them. This competence is an important building block of a firm's relationships with its supply chain partners, which helps generate valuable, rare, inimitable and non-substitutable abilities for the supply chain that are collectively known as supply chain competence (Hafeez, Zhang & Malak 2002; Prahalad & Hamel 1990; Wieland & Wallenburg 2013).

The theory of dynamic capabilities has been used to deduce the positive correlation between supply chain competence and innovation performance. Firms required innovation to make its processes, production operations, and products effective, feasible, valuable and of high-quality (Anderson, Potočnik & Zhou 2014). Innovation is a way for firms to navigate rapidly evolving external environments and tackle advancements in technology, increasing consumer expectations, and competition (Akdogan & Demirtas 2014). Using the theory of dynamic capabilities, Bleady, Ali and Ibrahim (2018) underscore that in order to tackle an evolving external environment, it is important to develop and redevelop capacities as critical resources and use them to gain competitive advantage. However, according to the theory of dynamic capabilities, competitive advantage is not only solely dependent on the availability of valuable, rare, inimitable, and non-sustainable assets of an organisation, rather, competitive advantage can also result from assimilation, integration of the resources and capabilities of an organisation and its partners, which can collectively help adapt in an evolving external environment (Bleady, Ali & Ibrahim 2018).

Dynamic capabilities can be understood as the capacity of firm to modify its resources and strategies to improve its performance and to gain a competitive advantage in a dynamic external environment (Teece 2018; Helfat 2007). Collaborations with supply chain partners, the knowledge acquired as a result of these collaborations, and the development of core skills and resources are all examples of dynamic capabilities, as also discussed previously (Teece 2018). The theory of dynamic capabilities posits that collaborations can generate supply chain competence by improving the relationships of a firm with its supply chain partners, and by encouraging that firm to invest in assets and technologies derived from these relationships. An increase in supply chain competence inherently results in an improvement in the innovation performance. Moreover, building supply chain competence also helps firms to improve their flexibility and responsiveness to changes in their external environment (Wagner & Boutelier 2002), which further increase their innovation performance.

To innovate continuously, firms must renew their competencies to keep abreast of the dynamic external environment (Teece et al. 1997). Moreover, in dynamic external environments, firms must monitor the changes in the environment, stay up to date with changing government policies, and develop the flexibility to respond effectively to these changes (Teece al. 1997). Thus, supply chain managers have to transform specific capabilities (such as forging collaborations, sharing knowledge, building trust, and balancing power) to ensure higher flexibility and promptness of response.

Chow et al. (2008) in his study examined the relationship between supply chain competence and overall performance and found that supply chain competence positively affects overall performance. Several studies have also explored the relationship between competences and innovation, discovering that the core competences of a firm increase its capability to innovate (Zirger & Maidique 1990). For example, Zirger and Maidique (1990) found that two of the five most critical determinants of product innovation are the usefulness of the product for the consumer and how well the new product aligns with the firm's existing competences. Innovations that align closely with a firm's existing competences are known to be more successful (Cooper & De Brentani 1991; Cooper & Kleinschmidt 1993; Kleinschmidt & Cooper 1991; Song & Parry 1997; Zirger & Maidique 1990).

Capabilities are derived from a merging of resources and core competences are derived from a merging of capabilities (Özbağa 2013). Thus, competences, such as supply chain competence, take time to develop. The purpose of supply chain competence is to provide to the consumer a product with the most value added to it. To achieve supply chain competence, a firm requires unique resources obtained by integrating the individual resources of its supply chain partners. It is necessary to perform an efficient, supply chain-wide integration of the unique resources and capabilities derived from supply chain collaboration. However, while unique resources are critical for developing supply chain competence, it is also important to integrate them effectively and repeatedly to maintain a competitive advantage over competitors.

The present study proposes that supply chain competences that improve innovation performance could be generated once supply chain partners involved in strategic relationship or involving their supplier in NPD processes trade their capabilities and resources within their supply chain. As these capabilities and resources are only accessible to those firms that are involved within their supply chain partnerships. This kind of engagement allows the supply chain partners to build supply chain competence, that in turn enhance their innovation performance to address a rapidly changing environment. Since innovation performance is the new competitive advantage in the modern business environment (Bashir & Verma, 2017, p.7).

Supply chain competencies serve as the foundation for supply chain innovation. Supply chain competency is crucial in today's changing economy (Jüttner & Maklan, 2011), as enterprises become increasingly reliant on value stream members and consumers' influence grows (Choi & Krause, 2006). Overall, it can be concluded that supply chain competency is a critical component of how a business interacts with its supply chain partners. Innovation enables businesses to manage quickly changing external contexts and address technological breakthroughs, rising customer demands, and competition. Increased supply chain capability necessarily leads in increased innovation performance. It is well established that innovations that are closely aligned with a firm's current competencies are more effective.

Therefore, supply chain competence and innovation performance are closely linked to one another, with better supply chain competence resulting in improved innovation performance.

Hypothesis 5: Supply chain competence is positively related to innovation performance.

Combining Hypotheses 3, 4 and 5, we propose hypotheses 6 and 7 below.

Hypothesis 6: Supply chain competence mediates the effect of strategic relationship with supply chain partner and innovation performance.

Hypothesis 7: Supply chain competence mediates the effect of supplier involvement in NPD and innovation performance.

3.5 Moderating Role of Absorptive Capacity

Absorptive capacity is considered as a dynamic capability which describes a firm's ability to collect, integrate, adapt, and leverage new external knowledge (Noblet, Simon & Parent 2011; Zahra & George 2002). Absorptive capacity can help a firm build a culture of organisational learning to enable the acquisition and application of new knowledge. Cohen and Levinthal (1990) stated that innovation can take place only when a firm is willing to recognise critical intelligence.

For a firm to be able to develop innovation, it is important to efficiently integrate and apply existing knowledge (Cohen & Levinthal 1990; da Costa et al. 2018; Egbetokun 2015; Egbetokun & Savin 2014; Ritala et al. 2015; Xia & Roper 2016; Abdul Basit & Medase 2019). Absorptive capacity is closely linked to building competence, the mechanisms used for learning, and knowledge sharing. These processes enhance a firm's capability to identify new sources of knowledge, to respond to changes in the external environment, to adjust to consumer demands, and to improve organisational creativity. Moreover, any firm's innovation phase depends on external sources of information (Cohen & Levinthal 1990). Therefore, firms that have a poor absorptive capacity find it difficult to integrate and leverage new knowledge, which has a negative impact on their innovation performance (Foss et al. 2011; Onyeiwu 2015). This shows that absorptive capacity is positively correlated with a firm's innovation capability and its willingness to integrate new learning obtained from supply chain partners (Nicholls-Nixon & Woo 2003; Azadegan et al. 2008). In the absence of adequate absorptive capacity, a firm will not be able to assimilate and utilise external knowledge or expertise. Overall, a firm must have both an absorptive capacity that allows it to acquire new information (Lewandowska 2015) and the actual acquisition of knowledge or information (Cohen

& Levinthal 1990; Thornhill 2006; Vinding 2006) in order to successfully enhance innovation performance.

Moreover, the integration of new knowledge in an organisation leads to enhanced innovation performance (Awwad & Akroush 2016; Hsieh & Chou 2018; Szücs 2018; Zach 2016). Ultimately, it is the absorptive capacity of firms that allows them to develop their products by utilising newly acquired expertise and organizational learning (Paiva et al. 2012; Olavarrieta & Friedmann 2008). Thus, absorptive capacity is an important dynamic capability which can substantially improve innovation performance.

Firms can widen their knowledge base by improving their absorptive capacity, which will subsequently help them improve their innovation performance (García-Villaverde et al. 2017). However, if firms decide to share their knowledge and learning with their supply chain partners, the nature of their relationships with their supply chain partners will also impact innovation performance (Krause, Scannell & Calantone 2000; Sukoco, Hardi & Qomariyah 2018).

Several studies have shown that absorptive capacity regulates firm's innovation outcome (Murovec & Prodan 2009; Zahra & Hayton 2008; Lane, Koka & Pathak 2002). For example, Kohlbacher et al. (2013) showed analytically the impact of absorptive capacity on the mechanism of innovation and contrasted it with the impact on the firms' competitiveness and dynamism. Similarly, Bertrand and Mol (2013) showed that absorptive capacity, aided by R&D, helps strengthen an organisation's relationships with manufacturers, thereby leading to enhanced product innovation.

Flatten, Greve and Brettel (2011) suggested that a direct link exists between the success of innovation and firm's absorptive capacity. This link arises because absorptive capacity imparts firm adaptability to the internal and external environments. Moreover, the effect of internal and external environmental factors depends on how well parties are able to acquire or disseminate knowledge. Others have argued that a formal management of acquired knowledge helps firms to build better and more efficient innovation practices (Su et al. 2013). Similarly, Fosfuri and Tribó (2008) found that the antecedents of absorptive capacity – such as collaboration in R&D, gaining knowledge from external sources, and knowledge experience – influence innovation performance. These studies suggest that absorptive capacity as a dynamic capability results in improved innovation performance. This is because firms with absorptive capacity can build capabilities which can allow them to better identify, pursue, and leverage opportunities, such as those provided by the strategic partnerships that they build with others. However, if firms are not willing to move out of their 'comfort zone' and explore what they do not know, they cannot build capabilities through innovation (Rai, Patnayakuni & Seth 2006).

Firms with a significant absorptive capacity will adopt and employ diverse concepts and ideas from external sources to create new knowledge and enhance their innovation performance (Martini 2017; Wales, Parida & Patel 2013). From the above studies, absorptive capacity gives firms the capability to merge their existing knowledge with the yet unknown, external knowledge acquired from suppliers, and put this new knowledge to their advantage. Thus, absorptive capacity is important for firms to develop and improve their capability to innovate by gaining external expertise. Absorptive capacity allows firms to acquire new expertise by building stable strategic partnerships (Easterby-Smith, Lyles & Tsang 2008). Easterby-Smith, Lyles and Tsang (2008) stated that a firm with absorptive capacity, that is, a firm that can readily acquire knowledge from external sources, also has the capacity to disseminate this knowledge among its members and partners. Moreover, absorptive capacity allows firms to acquire and utilise new knowledge obtained from their supply chain partners. Inkpen and Tsang (2005) found that a shared bond between firms allows them to share knowledge in a flexible manner, thus helping them maintain a sustainable competitive advantage. It should be noted that firms that lack absorptive capacity may still benefit from the knowledge shared within cooperative networks. However, the presence of absorptive capacity can help them realise the true potential of this knowledge and improve their sustainable competitive advantage.

Absorptive capacity can enable firms to optimise their supply chains on a global level, and thus to efficiently manage product flows and acquired knowledge, and to achieve shorter product development cycles (Rai et al. 2006). Absorptive capacity also allows firms to create highly complex and competitive products, thus highlighting their adaptive ability to innovate and devise future product development strategies that leverage new technologies (Liu et al. 2013).

Several studies have shown that expanding the external network of the firm can significantly improve its innovation performance (Rosell, Lakemond & Melander 2017; Taghizadeh, Rahman & Hossain 2018; Wang & Kafouros 2018). Moreover, firms with a high absorptive capacity are known to have better innovation performance and produce innovative products through efficient partnerships with their suppliers (Tsai 2009). Thus, absorptive capacity encourages firms to expand their innovation-related knowledge to include knowledge about market dynamics, strategic relationship with supply chain partner and competitors, stocking, and production (Liu et al. 2013).

In the context of the theory of dynamic capabilities, strategic supply chain partnerships and supplier involvement in NPD share a close relationship-lead innovation performance which, in turn, the strength of the relationship is impacted by firm's absorptive capacity. Firms leverage the skills and knowledge of their supply chain partners to enhance the value of the products and services they provide to their customers (Saenz et al. 2014). The greater the absorptive capacity of the firm, the better its ability to identify and mitigate external threats (Van Doorn et al. 2017). This means that absorptive capacity gives firms the capability to promptly identify and respond to the adverse changes in the external environment, thereby helping them develop positive growth (Yaqun et al. 2014). In other words, absorptive capacity acts as an enabler or a moderator.

Various supply chain studies have highlighted the role of absorptive capacity as a moderating factor. D'Angeloa, Ganotakis and Love (2020) found that the relationship between the growth of exports in an organisation and its innovation performance is positively moderated by the firm's absorptive capacity. Similarly, Zhu, Zhao and Abbas (2020) found that absorptive capacity positively moderates the relationship between innovation performance and investment in R&D. In another study about the pharmaceutical industry, Fernald (2017) found that absorptive capacity moderates the relationship between strategic partnerships and innovation success in the pharmaceutical industry. Though, existing literature has not investigated the role of absorptive capacity on moderating the relationship between strategic relationship with supply chain partner and innovation performance, in addition to the moderating role of absorptive capacity on the relationship between supplier involvement in NPD and innovation performance in the pharmaceutical industry.

Absorptive capacity may assist a business in establishing an organisational learning culture that facilitates the acquisition and application of new information. Firms with a limited absorptive capacity have difficulty integrating and using new information, which has a detrimental effect on their innovation performance (Jo, Park & Kang 2016). The stronger a firm's absorptive capacity, the more capable it is of identifying and mitigating external dangers (Van Doorn et al. 2017). This enables enterprises to react rapidly to undesirable events in the external world. In other regards, absorbent capacity functions as a moderator or catalyst. Therefore, to summarise the above discussion, absorptive capacity affects the dependence of innovation performance on supply chain collaboration. Based on this idea, hypotheses 8 and 9 have been formulated as follows:

Hypothesis 8: Absorptive capacity moderates the relationship between strategic relationship with supply chain partner and innovation performance.

Hypothesis 9: Absorptive capacity moderates the relationship between supplier involvement in NPD and innovation performance.

3.6 Summary

This chapter discussed the conceptual model that interlinks the various aspects that will be discussed in the present study. It further used this discussion to formulate the hypotheses to be tested in the present study.

4 Chapter Four: Methodology

This chapter describes the means of choosing a sutiable research methodology, research philosophy and paradigms; the research design and its various elements, as well as the reasons for its utilization; the research approach, strategy, and methods; the sampling process and the data analysis procedures; ethical considerations; disssmenation; and the pre-study.

4.1 Research Methodology

The methodology that guides the design is determined by factors such as the researcher's comprehension and interaction with the issue, as well as the data source. The researcher used the considerations (Blaxter et al. 2001) shown below in Table 4.1 which were taken into account when formulating a research methodology (Blaxter, Hughes & Tight 2001).

Table 4.1: Research methodology considerations

	Research methodology considerations
1	What does the research aim to find out?
2	What skills does the researcher possess?
3	Does the choice of the method seem appropriate for answering your research question?
4	How will the methodological choice influence the answer to the research question?
5	How will the researcher influence the research?
6	Which methods are considered to be appropriate and acceptable
7	Are you using one method or more than one?
8	Are you, as the researcher, considering the possibilities for change in the direction?

Chapter One identifies the aim, key objectives, and research questions for this study. To accomplish these objectives and to adequately answer the research questions, a specific direction must be established that balances the advantages and drawbacks of qualitative and quantitative methodologies. A researcher may determine the methodology that is most appropriate for the research. This should arise prior to the data collection and analysis processes (Blaxter, Hughes & Tight 2001).

To address a research problem, a researcher selects the relevant and appropriate methods from research methodology which is considered a broad domain. According to Sarantakos (1998), the two well-established research approaches are qualitative and quantitative research, basic description of which are shown in Table 4.2 below.

Table 4.2: Type of research

Type of research	Basic Description
Quantitative	"Quantitative is predominantly used as a synonym for any data collection technique (such as a questionnaire) or data analysis procedure (such as graphs or statistics) that generates or uses numerical data" (Saunders et al. 2009, p. 151).
Qualitative	"Qualitative is used predominantly as a synonym for any data collection technique (such as an interview) or data analysis procedure (such as categorising data) that generates or use non-numerical data" (Saunders et al. 2009, p. 151).

In order to clarify which research field is best suited to answer the research questions and is appropriate for the research problem, it is important to understand the basic philosophy behind quantitative and qualitative research. The next section will explain the research philosophy and paradigms.

4.2 The Research Philosophy and Paradigms

The research philosophy and paradigms are related to the way a researcher envisions knowledge development. As such, it is important to acquire an in-depth understanding of the research philosophy and frames as they influence the research strategy (Wilson 2010). Research paradigms enable the implementation of the research according to the specificities of a discipline and facilitate the result interpretation (Scotland 2012). A research paradigm comprises a set of beliefs which have a direct influence on the research theory choice, the research design and methods, data gathering, and result analysis, as well as result presentation and reporting (Hussey & Hussey 1997). The latter authors identify two research paradigms: positivism and interpretivism.

The positivism paradigm relies on the idea that the phenomenon of interest should be investigated or observed "directly," since only this "factual knowledge" is valuable and reliable (Harman 2010). The positivism paradigm is based on the view that the phenomena under research can be precisely isolated and are repetitive, and therefore one can maintain consistent observations on them and can thus infer the nature of the relationship between them. Traditionally, this research paradigm has been associated with positivist natural sciences. It has been widely and effectively applied to other areas of research, including that of supply chain management, to which the present study pertains. The adoption of positivism in other areas than the "original" natural sciences can be attributed to their capacity to provide objective, substantial/quantitative, and replicable results (Andrade 2009).

Indeed, the positivism paradigm is based on quantitative methods of data gathering and analysis, meaning it is a structured and logically elaborated, and therefore highly reliable approach (Hussey & Hussey 1997). Moreover, its findings, although based on finite sampling, can sometimes be extended to the entire population, based on logical and statistical arguments (Sobh & Perry 2006; Wilson 2010).

Contrariwise, interpretivism paradigm is founded that the idea of the "access to the reality," meaning the comprehension of the phenomenon of interest, can be only gained through socially built structures such as consciousness, shared meanings, and communication instruments, i.e., mainly language (Myers 2008). The interpretivism philosophy asserts that the knowledge of reality implies a subjective yet socially mediated interpretation and intervention of the researchers, the different study variables themselves being constructed socially and reflecting the current experiences, attitudes, and beliefs of the community (Feilzer 2010).

Taking into account the above considerations, the present study clearly ranges itself along the positivism research paradigm. The main subject of the study is explained in Chapter One. The relevant data was collected systematically with the purpose of sourcing the objective information necessary in defining and approaching the relevant variables.

Interpretivism philosophy was considered to be less appropriate for this study as it is not strategically designed to allow for the analysis of a causal relationship between the variables on an empirical basis (Burgess, Singh & Koroglu 2006). Also, the interpretivism paradigm would not have had any relevance in testing the hypothesis related to this question. The positivist paradigm, on the other hand, allows for a detailed evaluation of the different study variables, providing suitable tests for the reliability and validity levels of these variables and permitting the formulation and the testing of model hypotheses. The next section provides the details of the design of the research developed in this study.

4.3 Design of the Research

According to Wilson (2010), the research design is the detailed framework and the roadmap made of “best practice” parts that guides the researcher throughout the research process, as well as the support that increases the chances to reach the proposed research objectives during the imparted time frame. Sekaran and Bougie (2009) specified that a research design should address the following fundamental issues: (i) the purpose of the study whether it is exploratory, descriptive, or explanatory; (ii) the study settings (i.e. quantitative or qualitative); (iii) the research approach to which it should conform (i.e. deductive or inductive); and (iv) the proposed research strategy.

Research designs generally specify the extent of the researcher interference (i.e. a subjective or an objective research attitude), the time scope if any historical issues are addressed, as well as the degree of accuracy of data analysis (Sekaran & Bougie 2009). Other specific issues may be addressed, depending on the problem at hand.

4.3.1 Defining the Type of Research According to its Purpose

The research studies can be classified as exploratory, descriptive, or explanatory (Sekaran & Bougie 2009). According to Wilson (2010), exploratory research is carried out whenever one deals with a problem on which there is little, if any, knowledge or previous work done, and when there is a scarcity of information or research information of any kind. Also, when there is a lack of knowledege either on the condition that on hand or on similar past problems or issues (Sekaran & Bougie 2009). This sort of studies need an extensive preliminary work, and sometimes requires certain research experience in order to get familiar with the problem to be able to develop a set of working hypotheses. Quite often, studies of exploratory research are conducted based on qualitative research methods, including the use of interviews, historical observations and focus groups (Wilson 2010). Exploratory research is not adapted to an in-depth analysis of cause-effect relationships (Wilson 2010).

Descriptive research, as its name suggests, allows investigators to describe the relevant aspects of the research problems or phenomena (Wilson 2010), as well as the types of the variables in a given context, be it individual or organisational (Sekaran & Bougie 2009). Underlying descriptive research studies are generally simple descriptive statistics of the data in terms of frequencies, mean, standard deviation, and so forth. According to Wilson (2010), these descriptive studies provide accurate information which may eventually serve as a basis of simple decision-taking algorithms without allowing investigation of causality problems.

Finally, explanatory research is the only type that is useful in identifying the cause-effect relationship being solely concerned with asserting "why", as expressed by Dick, Heras, and Casadesus (2008). Acceding to Dick et al. (2008) the explanatory approach is on a par with quantitative research methodology, provided that the investigated variables fulfil three conditions that are natural to the causality realm, namely: (i) there is a "natural association" between the variables that might influence each another; (ii) the causal variable should, obviously, exert its influence before the outcome occurrence; (iii) one should eliminate any other possible explanations of the relationship between the two variables, such as a another variable that has an influence on both of them.

Explanatory research is appropriate to the current study objectives and deliverables since its focus is on the cause-effect relationship between the study variables. Moreover, according to Yin (1994), the explanatory research design also tries to link the causality hypothesis to the forces impacting the relationship between variables. Explanatory research design also provides one of the major strong points of the study. Namely, this research design is also suitable for a problem that has not previously been investigated in depth, and as such it can generate new operational definitions and offer better knowledge on the subject (Noor 2008). Furthermore, the explanatory research has the capability to simultaneously explain various aspects of the problem in a detailed manner because it uses various research methods such as survey and case studies (Marshall & Rossman 2014).

4.3.2 Defining the Type of Research According to its Setting

The current study uses a quantitative research approach based on the specific nature of the problem and the industry context. This study targets the pharmaceutical manufacturing industry, an industry that is heavily impacted by an increasingly aging population, a rapidly changing disease profile, and the large-scale adoption of modern medicine. In this respect, the issues of the supply chain and innovation performance are critical, as it impacts the activity and the success of the pharmaceutical industry. It is therefore imperative to explore how the features of the supply chain systems affect the innovation performance of pharmaceutical industry.

It was determined that a quantitative research approach is best-suited for the present research. Quantitative studies are the most appropriate when researchers aim to test the validity of a theory or hypothesis. Moreover, quantitative studies allow researchers to observe trends in data, interpret causality, and map the associations between different variables, thereby helping them arrive at definitive conclusions backed by adequate data (Kothari 2004). In the present study, some hypotheses were developed based on existing literature. Thus, a quantitative approach was deemed suitable to test these hypotheses.

The quantitative approach also helps eliminate (or reduce) bias in the results of a study, because there is no direct participation of the researcher in data collection or data analysis (if trends in data are discovered using statistical software packages). In comparison, studies that do not follow the quantitative approach rely on the expertise of the researcher to parse the qualitative data and interpret trends (Creswell et al. 2003). Moreover, quantitative analysis makes it possible to conduct time-sensitive research (i.e., the fact that they can follow the evolution of the results in time); the capability to check the reliability and validity of the results through various triangulations; and, furthermore, the structural ability to transpose the findings to a broader context, going from the particular context to the general context in a perfectly logical and coherent way (Queirós, Faria & Almeida 2017).

Despite these important advantages, this research design also has some shortcomings. For example, data collection in any quantitative research typically involves precise control over the responses of the sample population (Baxter & Jack 2008). Thus, quantitative research is less suited for fields guided by diverse and contradictory theories (Creswell et al. 2003). Indeed, the quantitative research approach is characterized by objectivity and not subjectivity, which can influence the interpretation of data in such fields. In the present study, the limitations of quantitative research were addressed by conducting a thorough review of the literature on how the variables analysed in the study interact with one another.

4.3.3 Defining the Type of Research According to its Approach

The research approach is one of the most significant aspects of the research process, and must be critically considered after the selection of the suitable research technique. The research approach identifies and offers a description of the reasoning behind the choice of the particular research method (Barratt, Choi & Li 2011; Smith 2015), and it is dependent on the study's purpose, whether exploratory, descriptive, or explanatory (Akhtar 2016). Business research methods might include either deductive or inductive reasoning approaches, the choice of either of the two types being determined by the nature of the study questions (Hair et al. 2010).

The deductive approach refers to elaborating upon a hypothesis derived from a given theory, and afterwards testing whether this hypothesis is valid for the particular observations of the studied phenomena (Johnson & Christensen 2008). The deductive approach involves formulating and testing the hypotheses (Barratt et al. 2011). It proceeds therefore from general to specific by starting with an expected theoretical pattern that is afterwards checked via the observations (Snieder & Larner 2009). It is largely used in quantitative research and areas with an abundance of data sources, both empirical and theoretical (Newman 2000). Its main advantages are the possibility of formulating a clear causality relationship between the concepts and the observations, as well as the ability to generalize some of the findings to other contexts (Antwi & Hamza, 2015).

On the other hand, according to Gioia, Corley and Hamilton (2013), inductive research approaches involve the collection of data and later using them in crafting tentative hypotheses and theories related to the phenomena of interest, identifying regular patterns in data collection. As such, the researcher focused on specific observations and later shifts from particular experiences to a more general set of propositions relevant to lived experiences (Lewis 2015).

The present study is then suited for the deductive approach. The hypothesis of the study, sourced from the theories as explained in subsequent chapters, was checked against a set of well-chosen variables and instances, which is a typical a deductive approach.

The deductive research approach offers additional advantages which guided the selection of this research approach in the present study. Firstly, the deductive approach equips the researcher to explain the underlying causal relationships shared between different study variables and concepts (Barratt et al. 2011). In the context of the present study, this means that the causal relationship between different study variables can be understood with the deductive approach. Moreover, the causal relationship of each of the study variables with innovation performance can also be elucidated. With the deductive approach, the researcher can also quantitatively measure the study concepts and, based on statistical analysis, to derive important and credible facts from the research data, including the specific trends of different variables (Bryman 2017). This is obviously different from the qualitative approach that only leverages from opinions, experiences, emotions, and personality characteristics, which can be often biased and unscientific. The next section addresses the research strategy/method of this study.

4.3.4 Defining the Research Strategy/Method

The aim of a research strategy is to lay out the complete path that a research process must undertake in a study. It is essentially a standard operating protocol for the researcher to address the objectives and questions of their research (Saunders 2011). No one research strategy is universally better than others. One must choose the research strategy that is suited to study objectives, the type and availability of data required, and the overall nature of the proposed research (Connell, Lynch & Waring 2001).

The present study follows the survey research strategy. This research strategy was deemed suitable for the present research because it allows for the collection of quantitative data and the analysis of such data via statistical tools (Forza 2002). Moreover, the survey research strategy is flexible, in that it allows the researcher to collect data from any kind of sample, whether large or small, based on the exact requirements of the study. The survey approach is not restricted to any specific field; rather, it enables the researcher to cover broader ground in their research, which is another reason why this strategy was selected for the present research. Additionally, in comparison to some other research strategies like case study research, the survey approach allows for the collection of useful data from larger samples even under financial or time-related constraints (King et al. 2004).

A researcher can genuinely distinguish between two survey research designs depending on their degree of remoteness from the original data sources (Dubé & Paré 2003). The case in which the researcher has a direct interface with all respondents is referred to as a primary research context. In a secondary research context, data are gathered from third-party sources. Both contexts have advantages and disadvantages (Dubé & Paré 2003). Primary research was applied to the present study design, in which data are gathered directly from volunteer respondents from pharmaceutical manufacturers. These are perceived as being ideal, first-hand sources with current views on the influence supply chain collaboration strategies have on innovation performance, mediated by supply chain competence and the moderating role of absorptive capacity.

From a phased perspective, the options for data collection include longitudinal design or cross-sectional design. Longitudinal studies adopt a “diary” approach in which case changes and developments in the study variables are addressed over a specific time period. Longitudinal studies are relevant when one of the basic questions is: *Has there been any change over a period of time?* (Saunders 2011). For instance, such a study can focus on administering workplace surveys for several years in order to establish observable changes in the development of human-related aspects; for example, human resource management or the evolution of the relations between employees.

Contrary to longitudinal studies, cross-sectional ones are just a snapshot at a point in time (Saunders 2011). Bryman (2006), who focused on a total of 200 published social science articles, noted that cross-sectional designs are the most frequent. The rationale for this was simply that the majority of the academic studies on management and marketing are significantly constrained by time issues. This study adopted a cross-sectional survey design as it considers as a preferred type in the literature.

The primary determinant of the quantitative method in this study was the research questions. Since the theoretical questions were answered quantitatively, the quantitative research strategy was matched to the chosen methodology and study theory. Additionally, the theory and structural model testing were not feasible to complete qualitatively. The quantitative approach used for this study due to the following reasons: (i) the research problem could be understood through quantitative data analysis, (ii) the deductive nature of the study helps to reduce subjectivity and bias in the research, (iii) it is important to study the phenomena statistically, (iv) the researcher is trying to investigate the relationship between the study constructs.

4.4 Research Process

Figure 4.1 below illustrates the research process which follow the sequence of: research topic selection, the literature review which examined dynamic capability theory, supply chain competence, supply chain collaboration strategies, innovation performance, absorptive capacity, and their relationships. Then, defining the research objectives, research problem, research questions, the significance of research and formulating of research hypotheses.

Another step is research design which presents a plan for how data will be collected, analysed and presented so as to answer the research questions and fulfil the research objectives. At the same time, it also provides an approach to tackle unprecedented issues with the research methodology – such as time constraints, research expenses, or obtaining access to relevant data. Upon conducting an extensive comparison among the various research approaches and philosophies, the positivist research philosophy was chosen, in addition to a deductive and quantitative scientific approach. To investigate the research questions outlined earlier, data were collected in the form of answers to a specifically designed questionnaire. These data were analysed and compared to the results reported in the literature review. The scientific contributions (both practical and theoretical) of this research were subsequently compiled and have been presented in the Conclusion (see Chapter Seven). Additionally, the limitations of the present research have been identified and recommendations for future research have been suggested.

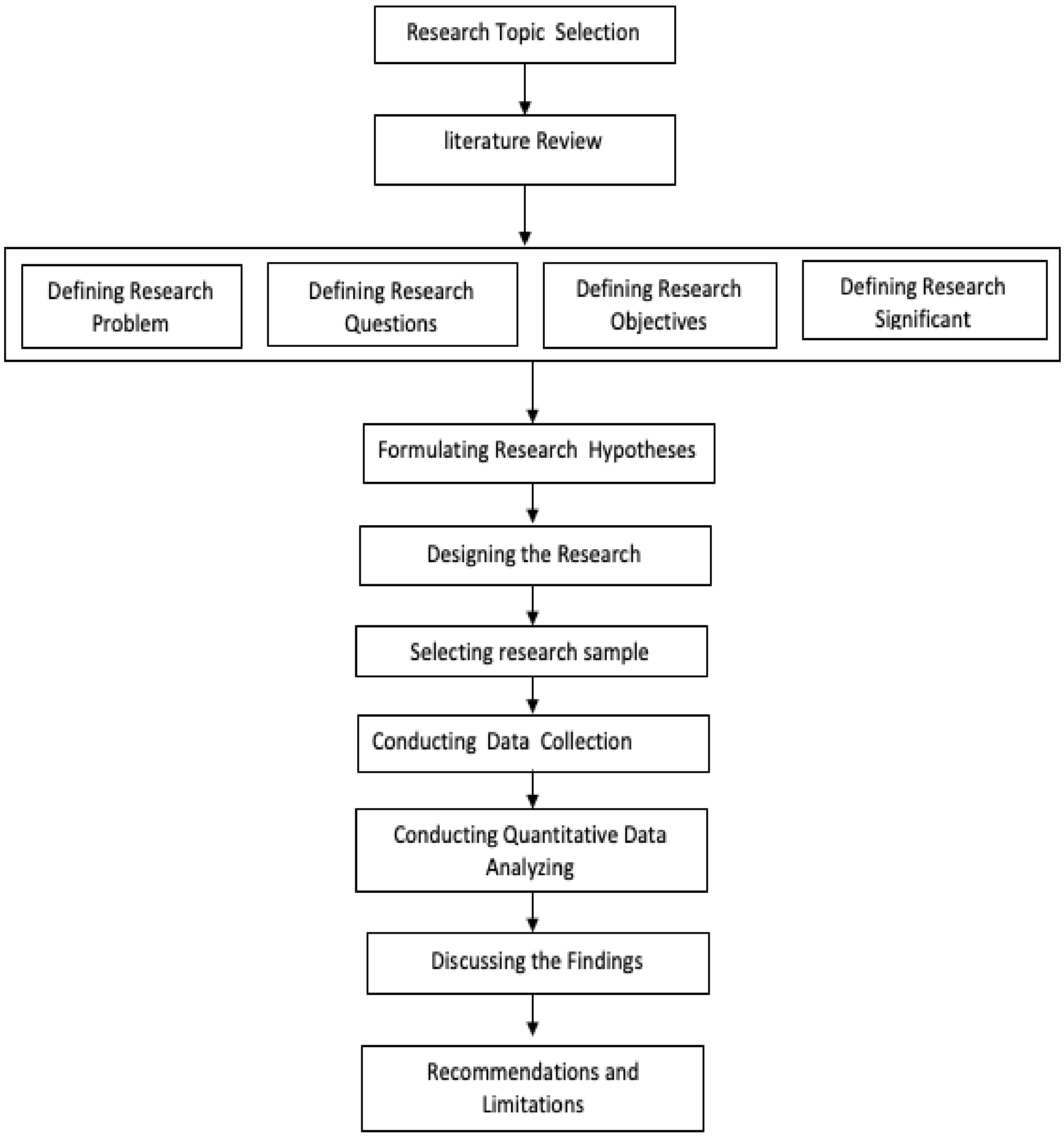


Figure 4.1: Research process steps

4.5 The Choice of the Sampling Process

Sampling is a statistical process wherein the researcher chooses a subset (or sample) of the data collected from a larger target population to note and interpret trends and make statistical inferences to fulfil the research objectives (Somekh & Lewin 2015). A sampling procedure generally involves the following steps, as illustrated in Figure 4.2 below: (i) the definition of the target population—or the sample universe—for which the statistical study is intended; (ii) the selection of the sampling frame, which is the collection of sampling units for which one can obtain the required data (i.e. eliminating from the target population the sampling units that are not available for data gathering, for one reason or another). This is an important step of the sampling process, namely putting the sampling units in their actual context; (iii) the choice of the sampling techniques (i.e., the way in which one selects the sampling units that will be part of the actual study). This stage is related to the fact that the researcher may be unable, often because of time or logistic constraints, to collect data from all the units in the sampling frame; (iv) the determination of the sample size, which is a compromise between the required quality of the statistical results, and the time or logistic constraints of the researcher; (v) the collection of the relevant data, according to a well-defined research procedure; and (vi) the assessment of the response and completion rate (i.e., the fraction of the sampling units that responded to the researcher request to participate in the search; Wilson 2010).

Figure 4.2: Steps of sampling process

4.5.1 Defining the Target Population

The target population is the totality of sampling units (i.e., individuals, organisations) from which one can extract a meaningful research sample (Taherdoost 2016). For this study, the target population is represented by supply chain managers and anyone else in the pharmaceutical industry that has a broad knowledge and experience of the supply chain management issues addressed in this research. This includes supply-demand planners, purchasing/procurement/logistic/supply chain managers, logistics engineers, and even owners or general managers in the pharmaceutical industry, while the departments for procurement, inventory and supply management are the most essential links in the dyadic relationship. Thus, the defined target population determined the sampling frame population.

4.5.2 Selecting the Sampling Frame

A sample frame is the subset of the target population that is potentially able to be part of the research process and to participate to the survey (Martínez-Mesa et al. 2016). For the current study, it was thought to be important to emphasis on the active operations pharmaceutical industry as a context of the sampling frame.

The most relevant pharmaceutical companies for the current study were collated from multiple directory lists such as PharmaExec and S&P Global Market Intelligence for MedWatch, as well as the sample frame collected by attending multiple international exhibitions such as CPhi Korea, CPhi Middle East, LogiPharma Switzerland, and ADPHAC Abu Dhabi - UAE. In addition, the exhibitor list from CPhi worldwide and CPhi India was used. The companies were researched afterwards via the LinkedIn search engine, then followed, and finally the company employee profile was researched and contacted. The target respondents were chosen based on the criterion of an in-depth knowledge of their organisation's supply chain processes and operations which were relevant to this study; they were, in general, upper-level managers or supply chain managers. Details of the selection criteria are provided in Table 4.3 below.

Table 4.3: Participants' selection criteria

Criteria		**Reasoning**
Industry	Active manufacturing pharmaceutical industry.	Many firms might be registered but do not have continuous active operations.
Position/Job Title	Senior or middle or operational managerial level.	Managers are more aware about the firm's strategies when testing supply chain collaboration strategies constructs.
Knowledge/Skills	Participant with some of the following knowledge and skills: operations, logistics, strategy, project management, marketing, sales, inventory management, procurement, supply chain , new product development.	The more knowledgeable the participants are the more valid results we can get.

4.5.3 Choosing the Sampling Technique

The sampling techniques refer to the algorithms that are used to select the sampling units that will be part of the study from the sampling frame. There are two sizeable categories of sampling techniques: (i) probability, using a random algorithm for sampling unit selection; and (ii) non-probability, based on a deterministic selection algorithm according to some predefined criteria (Taherdoost 2016).

Probability sampling techniques apply some form of stochastic selection procedure, the most common ones being cluster sampling, random sampling, systematic sampling, stratified sampling (Taherdoost 2016). The cluster sampling technique implies dividing the population into subgroups of “clusters,” yet these clusters should preserve the statistical characteristics which are similar to those of the whole population as much as possible. Then, instead of selecting individuals at random from each subgroup, the researcher randomly chooses entire clusters and uses them for data analysis. This sampling method is highly useful, for example, to researchers with participants spread thru a wide region as it saves both time and money (Taherdoost 2016).

Random sampling is based on the idea that every sampling unit has an equal probability of being chosen. This randomly chosen sample is expected to be an unbiased representation of the whole population (Taherdoost 2016). Although very convenient due to its simplicity, random sampling technique has some disadvantages, as in this technique all the population (each single unit) should be presented for sampling, but this is not possible most of the time. Also, this method has a high standard estimators error, which may affect data analysis and the final results (Taherdoost 2016).

Systematic sampling is rather similar to the random sampling, yet easier to conduct; namely, units are chosen at regular intervals following a random starting unit (Taherdoost 2016). When using this technique, however, one ensures that there is no hidden pattern inside the intervals which might result in a skewed sample (Taherdoost 2016).

Finally, stratified sampling is done in two stages: first dividing the population of interest into “strata” (i.e., subgroups, based on certain characteristic elements such as gender, occupation, business type, organisation type); and then proceeding to a random or systematic sampling for each strata, thus making sure that each stratum is represented adequately according to its size (Taherdoost 2016).

Non-probability sampling techniques are techniques that used when the selection is made according to a subjective judgement or preference of the researcher instead of random selection (Taherdoost 2016). The most common non-probability sampling techniques are self-selection sampling technique, convenience sampling technique, snowball sampling technique, and purposive sampling technique (Taherdoost 2016). Most of the resulting samples are biased, yet these techniques have their functions, sometimes as a rapid, preliminary evaluation of the results of the study (Taherdoost 2016).

The self-selection or voluntary response sampling technique is based on voluntary participation in the research process, once the researcher determines the sampling program intention (Etikan et al. 2016). Convenience sampling technique involves selecting available participants (Taherdoost 2016). It is inexpensive and simple compared to the other techniques, and therefore preferred among students. It can help overcome various limitations and barriers related to the study (Etikan, Musa & Alkassim 2016). For instance, using friends and/or family members for interviews removes the psychological barriers that might appear for the unexperienced researchers in the face of unknown persons. In the snowball sampling technique, early participants to the study themselves recruit subsequent participants, and so on, leading to a kind of exponential growth of the overall number of subjects (Etikan et al. 2016).

Finally, the purposive sampling technique is based upon a researcher's judgement, the sample being selected according to the purpose of the study (Etikan, Musa & Alkassim 2016). Kothari (2004) argued that this approach is useful in saving money and time, which are paramount in the research process. This technique is mainly used when the researcher seeks to obtain detailed knowledge about a specific phenomenon, is based on clear criteria and precise procedures for the selection, and is biased by definition. Purposive sampling techniques encompass total population sampling, deviant case sampling, expert sampling, and typical case sampling of individuals (Kothari 2004). The sampling techniques adopted in this study are non-probability and purposive. The selection criteria are shown in detail in Table 4.3 above.

4.5.4 Determining the Sampling Size

The sample size depends largely on the degree of variability of the study parameters across the population, on the sampling technique that is used, as well as on the degree of accuracy and robustness of the statistical findings required by the researcher (Wagner 2012). Using larger samples leads, in general, to more stable and accurate results (Blanche, Durrheim & Painter 2006). It is rare, however, that the choice of the final sample size can be made on precise quantitative arguments, it merely involves thorough judgment while experience is usually of significant help. In this study, a non-probability purposive sampling procedure was employed.

4.5.5 Data Collection

The survey was conducted from month of July to September 2019. The survey's results were analysed using a multivariate test. The measures deployed in the questionnaire originated from the previous academic literature on supply chain management, innovation, absorptive capacity, and supply chain competence. Appendix 9.2 shows the questionnaire structure of the questionnaire survey that was used to test the study's hypotheses.

All data collection procedures in this study were conducted to ensure the validity of the collected data. As such, it led to conclusions that can be applied anywhere in the world to issues related to supply chain and innovation performance. The survey questionnaire is the main data collection tool, thus the need to use a high-quality questionnaire. When conducting the survey, it was of paramount importance to assign the questionnaire to operational middle and senior managers who were in charge with the strategic, supply chain, and innovation activities of the firm. The questionnaire used a seven-point Likert scale with end points of “strongly disagree” and “strongly agree” measuring the responses given. The online survey was conducted using SurveyMonkey cloud-based software, which is suitable for quantitative studies involving a large number of respondents. It is preferable to use online surveys for quantitative research because the questions are standardised and the technique can be applied to a significantly large population. Another important advantage of SurveyMonkey is that it enables the export of data to IBM’s Statistical Package for Social Sciences (SPSS) for statistical analysis (Bhat 2019).

4.6 Designing Questionnaire

Designing a questionnaire procedure for data collection has several advantages, namely (i) to facilitate data gathering and the subsequent analysis; (ii) to maximize the participation and willingness to cooperate of the respondents, mainly due to the simplicity of the design, that allow them to record their answers within a well-defined framework; and (iii) to maximize the relevance and the accuracy of the collected data through a careful design (Martins, Loubser & Van Wyk 2002).

Apart from identified items in the demographic and general characteristics of the pharmaceutical industry, all the other key variables that were used in this study have been adapted from prior literatures to secure their content validity. Measures used in this study addressing issues related to strategic relationship, supplier involvement in NPD, innovation performance, absorptive capacity, and supply chain competence (Chen & Paulraj 2004; Chong et al. 2011; Oke et al. 2013; Roldán Bravo et al. 2016; Wagner 2012). They are depicted in Appendix 9.1 and also discussed below.

4.6.1 Strategic Relationship

Measuring strategic relationship with the supply chain partner was adopted from a study by Oke et al. (2013) that were originated from literatures of supply chain management (Chen & Paulraj 2004; Fynes, Voss & de Burca 2005; Li et al. 2005) which put the accent on the importance of building long-term partnership and strategic alliances for mutual benefits. The scale that this study used had been tested for reliability by Oke et al. (2013), who deemed it satisfactory with a Cronbach's alpha of 0.780. Four items were measured: (i) we expect our relationship with the key supply chain partners to last a long time; (ii) we collaborate with the key supply chain partner to improve performance in the long run (iii) the supply chain partner sees our relationship as a long-term alliance; (iv) we view our supply chain partner as an extension of our company. As is evident, primarily, the scale items measure the longevity of the relationship with the supplier, the extent of collaboration with the supplier, whether or not the supplier perceives the relationship as a long-term alliance, and whether the supplier is considered a strategic extension of the buyer firm. These items explain the primary construct of strategic relationship as underpinned by the dynamic capabilities' theory wherein the very act of forming an alliance with the supplier is considered to be a capability and enables the firm to co-create value, undergo organisational learning, and develop competitive advantage (Felin et al. 2012; Wang & Rajagopalan 2015; Kraaijenbrink et al. 2010). Furthermore, in terms of the longevity of the relationship that is developed between the buyer and supplier firm, the item explains the construct of strategic relationship as underpinned by the definition of Zimmerman et al. (2016) who stated that one of the criteria for a strategic relationship was that it was a long-term relationship between two or more parties. In addition, the item measuring the extent of collaboration is crucial as that can define the depth of the relationship which can impact the knowledge co-creation, organisational learning, knowledge sharing, and innovation management, all of which are essential characteristics of strategic relationships (Lambe et al. 2002; Ritter & Gemünden 2004; Sluyts et al. 2011; Cravens, Shipp & Cravens 2006). This is also crucial to measure due to the potential technological distance that can exist between the partner firms and the negative impact that it can have on the relationship (Phelps 2010).

Furthermore, measuring whether or not the supplier perceives the relationship as an alliance is also crucial as the perception that the supplier has with regards to the relationship determines the success of the relationship (Johnston et al. 2004). Finally, when the buyer firms perceive the supplier firm as an extension of their firm, suppliers will be more inclined share knowledge, provide resources, and engage in effective relationship management with the suppliers (Miocevic & Crnjak-Karanovic 2012). Thus, all of the four items represent a crucial aspect of strategic relationship and are essential in explaining the construct.

4.6.2 Supplier Involvement in NPD

In measuring supplier involvement in NPD, the unidimensional four-item scale developed by Chen and Paulraj (2004) was used, who confirmed the scale reliability with a Cronbach’s alpha of 0.860. According to Chen and Paulraj (2004) the construct is based on the involvement of the suppliers in new product development projects and planning processes. Four items measured a firm’s ability: (i) to involve key suppliers in the product design and development stage, (ii) to have key supplier membership/participation in project teams, (iii) to allow the key suppliers to have a major influence on the design of new products and (iv) to have strong consensus that supplier involvement is needed in product design/development. Wide range of researches have emphasised on the benefits of suppliers involvements in NPD process (e.g., Primo & Amundson, 2002; Ragatz, Handfield & Peterson 2002). Chen and Paulraj (2004) identified the construct based on a literature review across different disciplines. During the instrument development purification process, two items were deleted in order to improve the reliability and validity of their underlying theoretical constructs. Though two items were removed from the original supplier involvement in NPD construct (Chen & Paulraj 2004).

The four items that have been used are measuring the involvement of the key suppliers during the product design and development stage, the membership or participation of the key members into the project teams, the influence of suppliers on the design of new products, and whether or not the buyer firm agrees that there needs to be supplier involvement in the product design and development phase. For instance, measuring the involvement of the key suppliers during the product design and development phase is crucial as the extent of the integration during NPD is said to generate substantial benefits for the firm (Nagashima et al. 2015; Tan et al., 1998; Valkokari et al., 2012). Furthermore, the involvement of suppliers into the project teams has the potential to lead to joint-decision-making wherein the supplier and buyer firms can share information with one another effectively (Petersen et al. 2005).

Moreover, the influence of suppliers on the design of new products may indicate the presence of trust from the buyer’s side. This is representative in that supplier’s suggestions are being used and implemented in the product development. If this fails to occur, the supplier can perceive the integration as being one-sided and hence choose to integrate with another buyer firm (Zhang et al. 2010). The trust factor is also evident in whether or not the buyer firm perceives that there is a need for supplier involvement into the decision making as trust is a primary component of a successful supplier involvement (Henke & Zhang 2010).

4.6.3 Absorptive Capacity

Absorptive capacity is measured by unidimensional scale. In his study, Wagner (2012) measures absorptive capacity applied as a unidimensional construct because it is only calculated using a single measure. The scale is additionally used in supply chain research as a unidimensional scale by Roldán Bravo et al. (2016), and Roldán Bravo et al. (2020). Absorptive capacity is measured using four items adapted from Wagner's (2012) study who deemed it satisfactory the values for average variance extracted is 0.62 exceed the 0.50 threshold level. Reliability coefficient is larger than 0.70, with Cronbach alpha coefficient 0.80, and composite reliability coefficient CR 0.87. Four items measured a firm's ability: (i) to define adequate routines allowing it to analyse external knowledge from external partners, (ii) to identify relevant new knowledge from the external partners, (iii) to be able to successfully import and incorporate this new knowledge, and (iv) to develop new applications based on this knowledge. Absorptive capacity is defined as the "ability to recognize the value of new external information, assimilate it and apply it to commercial ends" (Cohen & Levinthal, 1990, p. 128). In other words, when firms have the ability to identify and analyse external information, which can be obtained from external partners, as well be able to incorporate this knowledge and apply it to develop new applications in a commercial setting. Measuring these items can provide a holistic picture of absorptive capacity. These items also measure the extent of organisational learning that occurs in the organisation, which is a core aspect of absorptive capacity (Cheng & Lu 2017). In addition, these items are also underpinned by the meta-routines that form part of absorptive capacity (e.g., Lewin et al. 2011).

4.6.4 Innovation Performance

According to Prajogo and Sohal (2001), though there are many classifications of innovation, several studies have mainly focused on product/service and process innovation. This study is consistent with literature that measured innovation performance which includes product/service and process innovation (Chen & Tsou 2007; Prajogo & Sohal 2001; Yamin et al. 1997). Innovation performance in this study is measured as a unidimensional measure which is consistent with previous studies which have adopted the same approach (e.g., Albort-Morant et al. 2018; Brettel & Cleven, 2011; Goffnett & Goswami 2016). We assumed that both product/services and process innovations are equally fundamental for attaining superior innovation performance. Furthermore, given evidence of participant in this study come from the pharmaceutical industry which highly rely on R&D. Chen and Tsou (2007) defined process innovation as “the changes in product or service delivery and/or development processes as defined by method, functionality, administration, or other features”. This study included process innovation and product/service innovation as measurement items of innovation performance which lead to changes and new technologies in the process and product/service features (Zhang & Chen, 2014, Utterback & Abernathy, 1975).

Innovation performance was measured based on items used to measure process innovation, as well as product/service innovation. Although they are recognised as two categories, the scale doesn’t include multidimensional variables. The scale was approved by the participants in the pre-study and used in research published in top scholarly quartile *Industrial Management & Data Systems*.

Furthermore, short, clear scales often produce higher quality data as respondents are not put off from participating in the research or completing long questionnaires, and are more likely to stay focused and concentrate on giving accurate responses. The scale consists of nine items, namely (i-ii) the interest in seeking new ideas and technologies, (iii) creative application methods, (iv) developing new processes for the supply chain operations, (v) capability of adopting technological innovations, and (vi-ix) the use of up-to-date or newest technologies in the new product development and processes, product novelty, and product introduction. This instrument was developed and validated by Chong et al. (2011), who indicated its reliability with a Cronbach's alpha of 0.910 and items factor loading range from 0.849 to 0.640. As indicated above, the items explain the construct by evaluating the extent of interest the firm has in seeking new ideas, whether there is a creative application method, whether they are developing new processes for the supply chain operations, whether or not they have the capability for adopting new technological innovations, and whether the firm uses new and advanced technologies. It was noted by Kahn (2018) that innovation is a process, hence, by identifying whether or not the firm is interested in seeking new ideas and concepts. Furthermore, by using new ideas and applying these ideas to the organisation, the firm needs to create new value for the firms (Narasimha & Narayanan 2013), which is also being carried out by the items. Thus, the items are explaining the construct of innovation performance.

4.6.5 Supply Chain Competence

The scale used to measure this construct was adopted from the scale that originally developed by Chow et al. (2008) and amended by Roldán Bravo et al. (2016). More recently, this scale had also been used by Roldán Bravo, Moreno, and Llorens-Montes (2018), and Roldán Bravo et al. (2020)

in the context of supply chain management, who also deemed it reliable. Derwik and Hellström (2017) recognize that supply chain competence is any organizational feature that supports the "ability of supply chains to respond to customer demands with low cost, high-quality products and services" (Bowersox et al. 2000). Chow et al. (2008) created the instrument on the basis of previous literature (Fisher et al. 1997; Reynolds 2003; Taylor 2004) that argues that firms must improve capabilities in order to succeed in market such as supply chain speed, inventory planning, forecasting and accuracy of data, order management, fulfilment, and procurement. The amended scale by Roldán Bravo et al. (2016) consists of eight items, namely (i) quality of product and services, (ii) on-time delivery and efficiency; (iii) order accuracy, responsiveness to the needs of customer and key suppliers, (iv) inventory optimization level, (v) ability to meet promises, (vi) forecasting accuracy, (vii) effectiveness of a tracking system, and (vii) the firm's level of integrity. Supply chain competence in this study is measured as a unidimensional scale as noted by Roldán Bravo et al. (2016), Roldán Bravo et al. (2018), and Roldán Bravo et al. (2020). In addition, the Exploratory Factor Analysis (EFA) that was conducted in the present research, shows that all the items were loaded into a single factor (Table 5.6). Thus, in line with the evidence, the scale amended by Roldán Bravo et al. (2016) was considered to be unidimensional in the present research. Furthermore, the scale as a unidimensional scale in research has been published in top quartile journals such as *International Journal of Production Research, and International Journal of Operations & Production Management.* The items of the scale measure parameters such as whether or not the firm is able to deliver the services on time, whether or not they have sufficient inventory, their ability to keep promises, their accuracy in fulfilling the promises, and the general processes of efficiency that occurs in the organisation. These items are relevant to measure the construct of supply chain competence due to the fact that supply chain competence is a measure of how well the firm is able to manage is functional, behavioural, and relational aspects (Derwik & Hellström, 2017). For instance, supply chain competence is measured by the extent of effectiveness that a firm has in areas of ICT, product development, agility of the supply chain, acquisition of knowledge, capabilities of the firm to fulfil its primary obligations, and the efficiency of the logistics, among others (Blome et al. 2013; Davis & Golicic 2010; Morgan et al. 2016; Shou & Wang, 2015; Thai & Yeo 2015). Since these items are also measuring the same, the items do indeed explain the construct of supply chain competence.

4.7 Data Analysis

In this study, data were transformed, modelled, and analysed using both descriptive and inferential statistics. While descriptive statistics describes, classifies, and summarizes data—in this case, the respondents and pharmaceutical firms' profiles—the inferential statistics offered a framework to make predictions with respect to larger populations (Wilson 2010). One of the main methods of inferential statistics was hypothesis testing, which is part of the deductive research approach adopted in this research. According to Wilson (2010, p. 237), hypothesis testing "involves making a statement about some aspects of the population, then generating a sample to see if the hypothesis is significant or not."

The data gathered for this study were analysed through a three-step quantitative procedure, namely: (i) an EFA, which is a preliminary stage meant to reduce the number of items involved in this research (i.e. the dimensionality of the data set) by eliminating those that are not "highly-loaded" on the research variables, (ii) a confirmatory factor analysis (CFA) that is meant to check that probability in the structure of proposed/hypothesised factor is supported by the sampling data (CFA is variant of the structural equation modelling [SEM]), and (iii) the structural model (also a variant of SEM) is the test stage of the research model and hypotheses. The next sections discuss these statistical techniques and the corresponding software applications used in this study.

4.7.1 Exploratory Factor Analysis

The EFA condensed the 29 questionnaire items used for the measurement of the five research variables of: (i) strategic relationship with supply chain partner, (ii) supplier involvement in NPD, (iii) innovation performance, (iv) absorptive capacity, and (v) supply chain competence. IBM's (SPSS) Version 23 was used for the evaluation of the high loading factors. The extracted factors were further used for the SEM – more precisely, for the CFA and for hypothesis testing. The next section addresses SEM used for this study.

4.7.2 Structural Equation Modelling

SEM is known as a multivariate statistical analysis technique, which is highly useful in analysing the relationship between the study's constructs (Farrell 2010). The application of SEM represents a combination of the various factor analyses and multiple regression analyses that allow a determination of the structural relationships between the measured variables and the latent constructs. An observed variable (also called an 'indicator' or a 'measured variable') can be measured directly, while an unobserved (or latent) variable cannot be measured directly and thus requires the use of other variables to infer it (Lowry & Gaskin 2014). Depending on the type(s) of variables involved, there can be two types of SEM: (1) models in which only observed variables are involved (such as path analysis or PA), and (2) models in which both observed and latent variables are involved (such as CFA, or the structural model discussed below; Jeon 2015). While

PA is similar to conventional linear regression analysis, it is often more useful than conventional linear regression because it can be used to estimate the indirect and total effects of one variable on another (Khine 2013). According to Khine (2013) PA is a specific case of a SEM wherein there are no latent variables. The mediating variables in both PA and SEM can be considered to be dependent variables with the assumption that the variables which have been taken to be independent variable in the conceptual model exert a causal effect on the mediating variables (Lleras 2005).

From the perspective of defining the relationship between variables, SEM has two kinds of effect: direct and indirect. While a direct effect is the immediate relationship between two variables, an indirect effect is a relationship between two variables that is mediated by one or more other variables. The total effect is defined as the overall outcome of both direct and indirect effects (Bollen & Davis 2009). Therefore, SEM can simultaneously derive the direct, indirect and overall relationships between the study variables. Moreover, it lets the researcher include multiple dependent variables, analyse the respective measurement errors for these variables, and elucidate the correlation between variables and between their measurement errors (Jöreskog & Sörbom 1984).

4.7.2.1 The Confirmatory Factor Analysis Model

The CFA model aims to analyse the contents of measurement models, including the structure and conformation of items to latent variables, and/or their indicators. It provides a means to verify a model created in advance, wherein the relationships between the composing elements have been created *a priori* (Afthanorhan 2013). Unlike the EFA model, the CFA model assumes that one can predict *a priori* the structure of the data, ideally by employing an accepted theory, and only needs to validate the predicted structure through empirical means (Khine 2013). The underlying technical objective of both these models is to elucidate the correlations and covariances among observed variables through a reduced set of latent variables (Khine 2013).

A measurement model can help estimate five kinds of parameters (Marsh et al. 2014), including: (i) coefficients linking the latent variables and their respective observed variables, (ii) coefficients linking latent variables with latent variables, (iii) coefficients linking latent variables with observed variables, (iv) variances and covariances of independent variables, and (v) variances and covariances of the errors in dependent variables. A measurement model can be identified if there exists a unique value for each of its parameters (Marsh et al. 2014). A measurement model is non-identifiable if it is not possible to estimate a free parameter from the data and an arbitrary parameter value is assigned (for instance, if a value of one is arbitrarily assigned to the correlation between two dependent variables; Marsh et al. 2014).

4.7.2.2 The Reasons for Adopting The Structural Equation Modelling

There are many advantages of SEM due to its extensive variety of applicability; this was the motivation for choosing this model for analysis. These modelling equations are normally applied in the assessment of many unobservable/latent constructs. SEM is also significantly useful in invoking the measurement model, which defines typically latent variables using single or multiple observed variables and a structural technique that depicts the existing relationship between these various variables. It offers a significant link between various constructs which can be readily estimated using multiple independent regression equations or other appropriate techniques. SEM allows the evaluation of multiple and interconnected dependences of the variables within a single framework (Byrne 2016).

Another advantage of SEM is that it is able to eliminate the errors that might occur in the data. Moreover, the analysis can incorporate both exogenous and endogenous constructs. Yet another advantage is that the utilization of SEM brings about highly useful results in social sciences because it has the ability to distinguish the relationship between observable variables from the unobservable variables (Tarka 2018).

SEM has the capacity to fit non-standard models, such as the flexible handling of longitudinal data, thus enabling autocorrelation of error structures through time series analysis as well as databases with variables that are non-normally distributed and incomplete data (Kaplan 2009). SEM also offers a unifying layout and framework through which numerous linear techniques can be fitted using flexible and powerful available software, unlike other multivariate techniques (Byrne 2016).

4.7.2.3 The steps of the structural equation modelling

SEM is generally used when a researcher has acquired previous knowledge or a highly plausible hypotheses about the relationships between variables. Quite often, there is a previously acknowledged theory underlying these hypotheses. Therefore, SEM analysis comprises making hypotheses driven by theory, and subsequently estimating the parameters in these model hypotheses (Tabachnick & Fidel 2007). The process or steps of the SEM analysis are described by the Schumacher and Lomax's (2004) diagram shown in Figure 4.3 below.

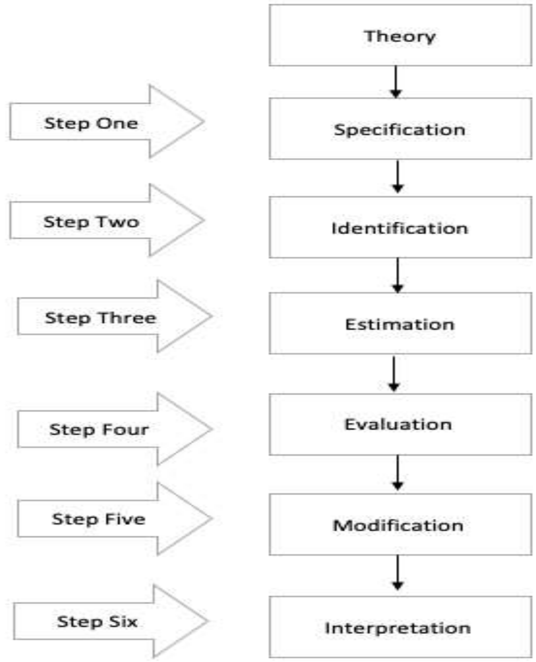


Figure 4.3: SEM process
(Source: Schumacher & Lomax 2004)

Step 1: Specification of the Theory and Model

In specification phase, the mathematical equations related to the causal effects of the latent variables and the expressions that link them to the observable variables or indicators are studied (Marsh, Hau & Wen 2004). The distinction is essential because any relationship between variables unspecified by the researcher is assumed to be zero. The latent is linked to the observed indicators through the measurement model after specification. Equation 1 and 2 below represents the specification process (Bollen & Noble, 2011):

Equation 1: Specification process

$$\mathbf{y}_i = \boldsymbol{\alpha}y + \boldsymbol{\Lambda}y\boldsymbol{\eta}i + \varepsilon i \text{ and}$$

Equation 2: Specification process

$$\mathbf{x}_i = \alpha x + \boldsymbol{\Lambda}_x \xi i + \delta_i;$$

In the above equation, y_i and x_i represent the observed indicators' vectors of ηi and ξi, respectively, whereas αy and αx are intercept vectors. Additionally, statements are made about the set of parameters at this stage, deciding between those that will be free to be estimated or fixed. A given value, usually zero, will be assigned. Likewise, the statistical assumptions about the sources of variation and specifically about the form of joint distribution are specified, which is considered multivariate normality in most of the techniques used (West, Taylor & Wu 2012). The clarity of the model is determined by the degree of theoretical knowledge that the researcher has on the subject of study. Suppose the information is not exhaustive or detailed. In that case, the assignment of the parameters will be confusing a priori, so the researcher will then have to make various modifications, mainly considering the theoretical aspects.

The model specification implies several considerations. The basic idea is that the researcher must devise a confirmatory model based on the covariance matrix of the sampling data, to propose "the best" model that fits this matrix (Kline 2015). This means that the researcher needs prior knowledge of the theories as well as reasonable explanations and assumptions in order to be able to specify the so-called "implied theoretical model." The choice of the model's variable is extremely important, since the erroneous exclusion of the important ones and, respectively, the inclusion of unimportant variables, will result in a mis-specified-implied model. This, in turn, will generate biased parameter estimates, a bias known as "specification error." Identifying this error and modifying the model to a more appropriate one (the so-called "model modification process") is a *sine qua non* step prior the estimation of the parameters in SEM based on the sample data (Kline 2015). The model in this research pursues the main objectives described in Chapter One and the conceptual model illustrated in Chapter Three, Figure 3.1.

Step 2: Model Identification

In the identification phase, the model parameters are estimated. It is determined whether a model is identified by an algebraic expression that demonstrates it based on the sample variances and covariances. Model identification determines whether the parameter estimation of the set model has a unique solution (Marsh, Hau & Wen 2004). If it is set incorrectly, the model estimation will neither converge nor have no solution. In this phase, the unknown parameters' values and their measurement errors are determined, for which various computer programs such as linear structural relations (LISREL), AMOS, and EQS are used.

It must be checked whether a model with a latent construct and all the indicator variables can be identified. It must be ensured whether enough information is available from the empirical data to estimate the model parameters unambiguously. A metric must be defined for the latent variables (West, Taylor & Wu 2012). Since the latent variables and the error variables represent unobservable variables, the scale on which the characteristics of these variables move is initially unclear. As part of the model identification, it is, therefore, necessary to assign a scale to these variables so that their characteristics can be interpreted. The number of unique covariances in the constructs should not be exceeded by the number of correlations in the exogenous variables and the estimated regression paths. This can be expressed through equation 3 below (Bollen & Noble, 2011):

Equation 3: Model identification

$$k(k-1)/2 \geq p + \#r_{exo} + \#r_{dist} + \#r_{exo}\&_{dist}$$

In the above equation

k = represents the number of constructs in the structural model

p = represents the number of (regression) paths

$\#r_{exo}$ = represents the correlations between exogenous variables

$\#r_{dist}$ = represents the correlations between disturbances

$\#r_{exo}\&_{dist}$ = represents the correlations between disturbances and exogenous variables

The key to the problem of model identification lies in parameter setting. It depends on how the parameter is set as a free, fixed, or a constrained parameter. A measurement scale has to be set for each latent variable of the model (Hu & Bentler 1998). There are two ways of setting the variables: one is to fix the factor load of an observation label to a constant, usually 1; the other is fixing the variance of the latent variable to 1, that is, to standardize the latent variable (Hu & Bentler 1998).

Step 3: Model Estimation and Evaluation

The model estimation minimizes the relationship between the sample variance or covariance and the variance/covariance estimated by the model. For a perfectly fitting model, the minimum difference function is zero. SEM estimation is based on Maximum Likelihood (ML) estimation. ML estimation is unbiased; has consistency; has asymptotic validity; and has asymptotic normality (West, Taylor & Wu 2012). In this way, the significance test of the hypothesis and the confidence interval of the calculation parameter can be performed. Moreover, the ML function is not limited to the measurement scale of the variable. ML fitting function is as shown in equation 4 below (Bollen & Noble, 2011):

Equation 4: ML fitting function

$$FML = \ln|\cdot\mathbf{\Sigma}(\theta)| - \ln|\mathbf{S}| + tr[\mathbf{\Sigma}^{-1}(\theta)\mathbf{S}] - P_z + (\mathbf{z} - \mu(\theta))\mathbf{\Sigma}^{-1}(\theta)\,\mathbf{(}z - \mu(\theta));$$

In the above equation,

S represents the sample covariance matrix

Z is the observed variables' sample means vector

P_z represents the observed variables

In represents the natural log

|.| represents the determinant

The main hypothesis tested is that the population variance and covariance matrix (Σ) is equal to the variance and covariance matrix associated with the theoretical model (Σ [θ]). In practice, this equality is difficult to achieve. However, the estimation methods allow finding θ (vector of parameters), in such a way that Σ is the closest to Σ (θ) (Marsh, Hau & Wen 2004). Since Σ is not known, the sample variance and covariance matrix (S) is used as the estimator of Σ. The difference between these two matrices S - Σ (θ) e is known as a residual. These residuals can quantify the discrepancy between what is observed through the data and the estimates derived from the model (West, Taylor & Wu 2012). The most commonly used estimation methods are ordinary least squares (OLS), ML, Generalized Least Squares (GLS), and unweighted or asymptotically distributed least squares. All these methods work iteratively, intending to minimize a fitting function. The adjustment function will depend on the estimation method used.

The ML method is used most frequently and requires that the normality of the data be fulfilled. However, it has been shown that the method remains consistent under minor deviations from normality (Hu & Bentler 1965). The OLS and GLS also work under the assumption of normality of the data. However, these methods yield more accurate estimates even despite violating the assumption of normality and, unlike ML, perform better even though the sample size is small (n <200) (West, Taylor & Wu, 2012). When the data distribution is not normal, the asymptotically distributed least squares method can be used. This method is used mainly when the model variables are categorical (polychoric, tetrachoric and pole serial correlations are used). However, the method requires the sample size to be significant. These considerations lead us to the very important aspect of the sample size. There are several elements to be considered:

(i) One needs enough points in the sample in order to be able to determine all the parameters of the model (Kyriazos 2018; Molwus, Erdogan & Ogunlana 2013). For example, a model with p parameters that exactly fit the conditional expectation function (a so-called "saturated model") has $p\ (p+3)/2$ free parameters, so more sampling points than free parameters are needed to determine the values of these free parameters.

(ii) Another element to be considered is the possibility that there is multicollinearity between the predictors, meaning that they are not linearly independent, meaning one of them can be linearly predicted from the others. This situation is reflected by a very small value of the determinant of the covariance matrix and must be solved through a better choice of the predictors before proceeding with the model (Allen 1997).

Inspecting the residuals is also highly useful in judging a model's suitability. Indeed, a good model should lead to small residuals centred around the origin and should have a rather symmetric frequency distribution of the residual covariances. Although complicated at first sight, the problem of finding "the best" model should stick to two fundamental ideas:

(i) The model should have "substantive meaning" (i.e., both theoretical and practical relevance). The steps are the following: each candidate model is hypothesised, the related data are gathered, then tested for meaning and significance.

(ii) The model should ensure a good statistical fit of the sample data and should have statistical significance.

Steps 5 and 6: Model Fit Modification and Discussion

If the fit is not good, the model needs to be reset or modified. It is necessary to decide whether to add, delete, or modify the parameters in the model. Once the model is identified and the parameters have been estimated, only two steps are essential for any analysis: its evaluation and modification to verify whether the data has been adjusted to the proposed model (Hu & Bentler 1998). The usefulness of the model will be given by its ability to explain the observed reality. This capacity must be evaluated both for the model as a whole and for each of the relationships expressed in it. Every latent variable should have a scaling indicator as shown in equation 5 and 6 below (Bollen & Noble 2011):

Equation 5: Model fit

$$\mathbf{y}_{1i} = \eta i + \varepsilon_{1i} \text{ and}$$

Equation 6: Model fit

$$\mathbf{x}_{1i} = \xi i + \delta_{1i};$$

In the above equation, y_{1i} represents ηi scaling indicators while x_{1i} represents ξi scaling indicators. When the latent variables are eliminated, equations 7,8, and 9 are formed (Bollen & Noble 2011).

Equation 7: Model fit

$$\mathbf{y}1i = \alpha\eta + \mathbf{B}\mathbf{y}1i + \mathbf{\Gamma}\mathbf{x}1i + \varepsilon 1i - \mathbf{B}\varepsilon 1i - \mathbf{\Gamma}\delta 1i + \zeta i;$$

Equation 8: Model fit

$$\mathbf{y}2i = \alpha_{y2} + \mathbf{\Lambda}\mathbf{y}2\mathbf{y}1i - \mathbf{\Lambda}\mathbf{y}2\varepsilon 1i + \varepsilon 2i; \text{ and}$$

Equation 9: Model fit

$$\mathbf{x}2i = \boldsymbol{\alpha}_{\mathbf{x}2} + \mathbf{\Lambda}x2\mathbf{x}1i - \mathbf{\Lambda}\mathbf{x}2\delta 1i + \delta 2i:$$

There are three alternatives to evaluating the model: the evaluation of the fit of the global model, the evaluation of the fit of the measurement model and the evaluation of the fit of the structural model (West, Taylor & Wu 2012). Several goodness-of-fit indices will appear associated with each estimate that must be interpreted to conclude if the model is consistent and fits with the empirical data. It will be its correct interpretation, both individually and globally, that determines whether a model is accepted or not.

The estimation of the goodness of fit is a critical question, and an answer to it is offered using several indices. This is a complex issue and subject to debate since each of these indices has its benefits and limitations (Fan et al. 2016; Moss 2009). This study used the following indices:

(i) The chi-square absolute/global fit index, which tests the null hypothesis.

(ii) The adjusted or normed chi-square obtained by dividing chi-square by the number of degrees of freedom and is less sensitive to the sample size issues.

(iii) The root means square error of approximation (RMSEA) related to chi-square is also an absolute/global fit index which measures how far a hypothesised model is from a perfect one.

Besides these global/absolute indices which compare the hypothesised model with a perfect one, this study also used relative/incremental adjustment indices that compared the chi-square for the hypothesised model with the chi-square for the so-called "baseline" model. This is a primitive model which omits the latent variables (i.e., in which all measured variables are independent):

(iv) The comparative fit index (CFI) takes model complexity into consideration by employing a non-central chi-square distribution. CFI helps prevent the underestimation of the adjustment in the NFI when working with a small sample size.

(v) The Tucker-Lewis index (TLI), equivalent to the Bentler-Bonett Non-normed Fit Index (NNFI)

(vi) The Bentler-Bonett Normed Fit Index (NFI)

(vii) The incremental adjustment index (IFI)

While there are many other indices that are used by SEM practitioners, this study focuses only on these ones. The application of these indices relies on a series of limit criteria, which is also a matter of ongoing scientific debate. For example, RMSEA around 0.05 is a “close fit,” while RMSEA around 0.08 is a “good fit” (Marsh, Hau & Wen 2004, p. 321); TLI close to 0.90 suggests a “good fit” while close to 0.95 is a “close fit” (Kline 2015); CFI, NFI, IFI around 0.9 are “desired.” (Garson 2015; Ullman 2001).

4.7.3 Analysis of Moment Structures

AMOS is a statistical software—a specific module of SPSS—whose name stands for the “analysis of moment structures.” It has a wide range of applications (e.g., SEM, PA, CFA) and uses various methods for model estimations, namely ML, OLS, GLS, as well as unweighted least squares, being optimised for SEM-related complex computations, and is used for standard or personalised result display (Bacon & Bacon 2001).

The other advantage of AMOS is the “AMOS graphic” window that offers various useful features to easily visualize and interpret data, such as the tool for attaching data, observed variables, unobserved variables, covariance, cause-effect relationship, naming variable, and error term (Byrne 2016). The graphical user interface is effective, and the analysis can be performed by the intuitive work of actually drawing the path diagram and applying it to the data (Afthanorhan, Ahmad & Safee 2014).

The AMOS program is highly accurate in examining the hypothesised model. It estimates the path model via the establishment of a variance-covariance matrix and also reads the path diagram as input. The overall and incremental fit of the quantitative research model was assessed using various options and features of AMOS. The program also served for the CFA, for all the measurements of the research, hence confirming the adequacy of the models used (Byrne 2016). AMOS, through PA, enables testing the relationship between variables that are measured directly; all variables are denoted by boxes. It also enables testing of the relationship between latent variables; factors that cannot be measured directly are measured indirectly from the aspects that are thought to be related (Afthanorhan, Ahmad & Safee 2014).These features make AMOS the most suitable choice for the current quantitative research as compared to other methods and available software solutions.

4.7.4 Measuring Reliability and Validity

The researcher was vigilant in checking and ensuring the validity and reliability of the sample gathered data and latent variables, as these are fundamental elements for SEM. The study used two measures for the reliability of the research variables, namely (i) the Cronbach's alpha coefficient that is a measure the internal consistency of the group of research variables under consideration; and (ii) composite reliability (CR), which was used as a measure of the internal consistency of each of the latent variables (i.e. constructs) of this study (Hair et al. 2010).

The validity of the constructs was measured using two frames, the first of which was convergent validity (Cooper & Schindler 2006) which indicates the homogeneity degree of the measurement items relating to the construct. More precisely, these are expected to be highly correlated among them with each individual's factor loading on the latent variable above a threshold value of 0.5 in order to have convergent validity of the construct under study (Anderson & Gerbing 1988; Sekaran & Bougie 2009). The second frame was discriminant validity (Saunders et al. 2009), which refers to the degree of heterogeneity of the measurement variables relating to different constructs. Discriminant validity requires that the latent variables are predicted as being uncorrelated with measurement indices loading differently and separated on each of them (Sekaran & Bougie 2009). Following Fornell and Larcker's (1992) research, this study ensures there is discriminant validity based on Average Variance Extracted values are more than the value of the shared variance (square of the parameters estimate) between variables. The next section addresses the ethical considerations relating to this study.

4.8 Ethical Considerations

The study received the approval of the Board and Ethical Committee of the British University in Dubai, as shown in Appendix 9.3. This is a preliminary undertaking, confirming that the University, as an institution, supports ongoing scholarship in this area. Before research is carried out, it is necessary to obtain approval from a research university as part of the legal factors to be considered. Any research study that is not approved by the University is considered illegal and therefore unethical. It is on this basis that the research study was approved by the University before its commencement. The research was therefore carried out according to the informed consent shown in Appendix 9.4.

Several ethical issues were taken into consideration in this study. Some of these include keeping the participants' identities and their places of employ confidential. There are some respondents who preferred to answer their questionnaires under the condition that their identity was not disclosed, and these boundaries set by respondents was respected. The quality of the research design was one of the major ethical aspects that was taken into account. Honesty and integrity of the due process is a great aspect of consideration (Ritchie et al. 2013). No irrationality or form of manipulation will be attempted with the data used for this study. In addition, no form of exaggeration was reported during data collection, data entry, or data analysis.

Openness and objectivity are also ethical aspects to be considered. The findings of the study will be shared broadly with other scholars with the aim of promoting knowledge. The objective of any research study is to add to the existing knowledge or to create new knowledge in each discipline; therefore, the study will remain steadfast in fulfilling its intentions. Voluntary participation was solicited such that no informant was coerced to participate in the survey. This assisted in gathering quality respondents for the analysis in this study. Also, respect for intellectual property has been ascertained through referencing and the use of in-text citations as well as quotations for the materials sourced from other scholars.

4.9 Dissemination

Once the research is complete, it will be disseminated to various consumers. Dissemination will be carried out by preparing the findings for publication and presenting the findings at various conferences. Use of publications and conferences is a critical path to research findings' dissemination for scholarly work that adds additional knowledge into the discipline and encourages application by professionals (Bell 2014). For the publication method of dissemination, the findings will be posted on websites as well as hard publications for easy access and use by other scholars in the institute library. As for conference presentations, the research will also be presented to and discussed with faculty members in the researcher's department for necessary feedback and suggestions. Subsequently, the findings of this research will be disseminated to other scholars in the field.

The present study attempts to improve upon the existing theory and concepts so as to aid and encourage additional studies by other researchers. Hence, the present research will be shared with other researchers in the field to encourage constructive criticism and support further research. This research may also serve as an aide for pharmaceutical manufacturing industry to understand the antecedents of innovation performance in supply chain context. Therefore, this research will also be disseminated at conferences frequented by supply and purchase directors and executive leaders in supply chain management and innovation.

4.10 Pre-study

A pre-study, where *pre-* stands for "preliminary," is the process of conducting a familiarity test which seeks to assess the success of an actual study before doing the actual research (Kinchin, Ismail & Edwards 2018, p. 12). A pre-study seeks to increase the researcher's scope regarding the research environment and the research components. It is a critical activity that can prevent potential research problems through initial investigation on a small scale. Most studies that feature pre-study activities increase their likelihood of delivering positive outcomes and research objectives. This comes as a consequence of adopting a proactive approach to identify and troubleshoot any problems that could be detrimental if encountered during the research itself (Kinchin et al. 2018). Pre-study is especially critical in assessing the suitability of the research data collection method for survey design and research steps. Pre-study surveys are essential in testing survey design in a small, controlled population before the research survey is conducted on the larger study population (Kinchin et al. 2018).

The primary purpose of pre-study in quantitative research is to measure the capability of the designed survey to deliver expected research outcomes. A survey designed for quantitative research can contain implementation problems and deficiencies if it is conducted without a pre-study in a controlled manner (Majid et al. 2017). Therefore, the primary purpose of a pre-study is to avoid problems with the design and scope of survey during the advanced stages of the research where it would be costly to redesign the study and the overall research activity.

The major aim of this pre-study was the evaluation of the efficiency and reliability of the research instrument that were adapted from previous studies (Chen & Paulraj 2004; Chong et al. 2011; Oke et al. 2013; Roldán Bravo, Moreno & Llorens-Montes 2016; Wagner 2012). Before starting the data collection process, it is therefore important to investigate whether the research instruments are robust and as such this pre-study is a first step towards that goal. A pre-study of the survey has many benefits. To start, researchers are able to ensure that the questions are well-designed and that the responses are not only a representation of the respondents' point of view, but are also comprehensive, realistic, mutually exclusive, and not influenced by the researchers' own perspectives (Converse & Presser 1986).

According to Silverman (2013), there is great importance placed on conducting a pre-study. It not only reveals gaps in the research instrument, but also allows one to build up confidence in administering the research. Bryman and Bell (2016) stated that the pre-study can be beneficial in cases where the functioning of the research instrument is to be evaluated. In addition, the authors stated that the survey questions' effectiveness can be assessed. According to Converse and Presser (1986), a pre-study is an essential means to identify possible issues, decrease errors in measurements, reduce respondent burden, get feedback on respondents' ability to understand the questions, and ensure that the sequence of questions does not influence the way a respondent answers. In other words, a pre-study is a critical investigation of a survey instrument that helps to test its functionality, validity, and reliability before its use in the actual study. Furthermore, Bryman and Bell (2016) stated that a pre-study can reveal those questions which generate standard answers, and which can then be eliminated as irrelevant from the primary study.

Another benefit of the pre-study is that it allows for the assessment of whether or not the respondents understand the survey questions; this is one of the main concerns in a survey design, and a pre-study is considered to be one of the best ways to assess this (Converse & Presser 1986).

Moreover, the pre-study is an essential approach to streamlining data collection and analysis methods to measure the research hypothesis. Different data analysis methods can be used in a pre-study to choose the most relevant data analysis approach for the final research (Van Teijlingen & Hundley 2001). Likewise, a pre-study allows the researcher to assess the amount of time it takes to complete the full survey as well as each individual section of the survey.

From the above, it is evident that the pre-study stage of a research instrument is important to reveal its inefficiencies and to develop any appropriate rectifications. In addition to evaluating research instrument consistency and robustness, a pre-study also enables the researcher(s) to become familiar with administering the research instrument.

4.10.1 Pre-study sample group

Although the survey measurement instruments used in this study have been utilized, fully tested, and validated in other supply chain research studies, they were additionally pre-studied to confirm their reliability. In this study, the pre-study was conducted with a sample group consisting of 40 individuals: one participant from one pharmaceutical manufacturing industry. Selection was based on the participants' knowledge of the PSC field. Characteristics criteria of the respondents made obtaining large number of participants difficult; however, a sample of 40 is sufficient for basic internal reliability testing. Seven participants were met face-to-face while attending conferences in Montreux, Switzerland for LogiPharma, and Abu Dhabi, UAE ADPHAC in the month of April 2019. The other 33 participants were sent an electronic survey via email. Respondents were informed that the survey was part of a pre-study. The basic idea behind this approach was to involve the participants in the pre-study more effectively instead of simply asking them to complete the questionnaire, to invite them to give their feedback, and expand on their reactions to the survey questions. The respondents of this pre-study were subsequently excluded from the main survey sample.

4.10.2 Pre-study mode of administration

Survey instruments can be distributed using multiple modes of administration. A first mode is face-to-face interaction using an electronic web-based survey link through a tablet device (i.e., iPad), and a second mode of administration is an electronic survey through an email. Using different modes for data collection impacts the instruments used during the evaluation and analysis of the gathered data. The implication for this study is that the answers to the survey questions may be affected by the way they were submitted to the respondents. Therefore, testing these submission methods should be a point of the pre-study.

Several prior academic studies (Janghorban, Latifnejad & Taghipour 2014; Kinchin, Ismail & Edwards 2018) suggested that there are various reasons for which the administration technique should be the same for the pre-study and the full-scale study. For that reason, this pre-study was also conducted through two modes of administration. From the sample size of 40 individuals who work in the pharmaceutical manufacturing industry, and seven participants who filled in the survey by the first mode which was face-to-face interaction using a tablet device. The other 33 participants filled in the survey using the email survey.

4.10.3 Pre-study method

During the data collection of the pre-study, participants were observed for their behavioural interaction. Immediately after the participants completed the survey, we all met and engaged in a small question-answer session, where they were asked about the ease of answering questions, time spent, question clarity, and other enquiries to conduct a valid and reliable pre-study assessment of the survey illustrated in Appendix 9.5.

In the pre-study assessment, the researcher administered the survey and asked each of the seven respondents who work in the pharmaceutical manufacturing industry to take the survey in the presence of the researcher, the other 33 respondents were asked to submit their feedback through email. Behaviour was observed during the survey for the seven respondents as it may indicate problems with the survey questions such as confusion, frustration, and hesitation. When the respondents finished taking the survey, mistakes and skipped items were noted. These indicated issues in the scale logic and clarity of questions, among other problems. Those who participated in the pre-study were provided with definitions of the word “absorptive capacity” to ensure there was no ambiguity in the meaning of this definition as it is relatively new and not yet widely studied or known. To solve this issue, this study adopted a procedure that is highly effective when the construct is new and less known in the field (Lawshe 1975). Observing any difficulties with terminology will allow the researcher to edit this language in the full-scale survey, since understanding verbiage in a questionnaire is an important aspect, especially for a survey within a very specific field like supply chain management.

4.10.4 Pre-study results and analysis

The survey questionnaire have five sections: demographic section, supply chain collaboration strategies section, absorptive capacity section, innovation performance section, and supply chain competence section. There were no comments or feedbacks from the participants about the questionnaire clarity for the demographic section. Though, based on visual data analysis the researcher observed that some questionnaire required some modification. As the following, for the question related to job title, many participants selected "Other" in the job title question, so it was suitable to add the most common job said to the selection criteria which was "Key Account Manager." Moreover, the question of "company years of experience" was changed to "How many years has the company you work for been operating in the market?" as many participants are confused as to whether the question related to their own experience in the company or the number of years their company has been operating in the market. Another issue with this question was that it produced answers which indicated the specific length of time. Thus, it warranted changing to fit the target of the data collection sample and to facilitate the analysis of the data that will be changed accordingly using a three-year time designation: <3 y, 4-6 y, 7-9 y, …, 19-21 y, >21 y.

For the other sections, measurement items were evaluated both individually and as a group based on their construct. The second section is the supply chain collaboration strategies, which consists of two constructs: strategic relationship with supply chain partner, and supplier involvement in NPD. The first construct is the strategic relationship with supply chain partner, which includes four items with which there was no confusion, frustration, or hesitation in the respondents' behaviour while answering the question, and no ambiguity was observed in the measurement items. For the supplier involvement in NPD which included four items, one respondent highlighted that there was confusion between item number 1 and item number 4 as the participant felt it was a duplicate question. As questions were perceived to be repetitive from the participant's perspective, such respondent comments are common, but it was better not to edit or change the published validated scales. These questions and why apparently similar questions were included in the scale were explained to the respondent; for instance, they are, in fact, subtly different and that in scholarly research, it is usual to rely on questions already proven reliable in previous studies. Both supply chain collaboration strategies constructs should be answered by participants who are in a managerial-level position in the supply chain. This required an understanding of cooperation between different departments and respondents and increased the possibility of incorrect information if the survey was given to the wrong participants.

The third section related to absorptive capacity of the firm. The absorptive capacity section consisted of four items. Ten percent of the participants indicated that item number four seemed repetitive and confusing. Overall, the participants commented that the items were well-structured and related to one other; this confusion might have happened because the concept and term are new and not widely researched. However, the definitions were clearly stated at the beginning of the questionnaire.

For the fourth section, innovation performance, one out of the seven interviewed participants found item number 7 confusing, particularly the word "fax." The word "fax" was a typographic error transferred unintentionally from a previous study (Chong et al. 2011), and was subsequently changed to "fast." For the fifth section which related to measuring supply chain competence, there was no ambiguity in any of the eight questions.

The general assessment of the questionnaire was that its function was relatively well-structured and easy to understand. However, some general issues were identified: the ranges of questions comprised of different topics required cooperation between different department managers. This increased the possibility for incorrect information due to lack of knowledge in certain areas. Some questions were not appropriate for all activities; many of them were too manufacturing oriented. This presented a great challenge for respondents who often answered questions with a ‘Neutral’ response. The technical terms and terminology used were not always understood by respondents. Hence, for the reasons given above, selecting the proper participants within the target sample group is a crucial factor that should be taken into consideration prior to distributing the full-scale survey.

4.10.5 Pre-study reliability measurements

As discussed above, the reliability estimation refers to the assessment of the consistency level among multiple measurement items of a latent variable (i.e., construct; Hair et al. 2010). This assessment can be made using several methods that reflect the internal consistency of the variables, the most common being Cronbach’s alpha. Although only highly reliable and validated scales are adapted from previous different studies, Cronbach’s alpha was still used in this study in order to assess the internal consistency since previous studies were conducted using employees of different manufacturing firms and due to the uniqueness of the scope of supply chain practices in the pharmaceutical industry.

Reliability analysis is conducted to examine scale measurement items. When the items in the scale do not correlate adequately, this indicates their low reliability, and hence they do not relate to the same construct (i.e., latent variable; Hair et al. 2010). To check the internal consistency and exclude the unreliable items, Cronbach's alpha was applied.

Internal consistency is excellent when Cronbach's alpha is over >0.90 (Hair et al. 2010). However, values greater than 0.92 may indicate that the correlation between items is too high, suggesting that some items might be redundant and not measuring anything new. Cronbach's alpha is good when it is between 0.89 and 0.80, 0.79 to 0.70 is acceptable, and questionable from 0.60 to 0.69. It is considered poor when between 0.50 and 0.59 and unacceptable when less than 0.59 (George & Mallery's 2003).

According to Nunnally and Bernstein (1994), a Cronbach's alpha of 0.70 is the minimum acceptable level to measure reliability, while Hair et al. (2010) argued that 0.60 is still an acceptable level provided the scale contains at least two items. Obviously, no further statistical analysis can be conducted beyond that. As for factor analysis, a minimum of 100 respondents is required (Hair et al. 2010).

The reliability of the measurements in this survey was tested on five measurement scales using Cronbach's alpha, with the following obtained values: (i) for the strategic relationship with supply chain partner: 0.956: (ii) supplier involvement in NPD: 0.945; (iii) absorptive capacity: 0.809; (iv) innovation performance: 0.917, and (v) supply chain competence: 0.909. As the Cronbach's alpha values ranged from 0.809 to 0.956, all the adopted scales are reliable and imply that all the variables have significant internal consistency, according to Nunnally and Bernstein (1994) study. Although the strategic relationship with supply chain partner Cronbach's alpha (0.956) is higher than the desirable value, the researcher preferred to remain with these previously validated scales since this might simply represent a fallacious result due to the sample size impact on Cronbach's alpha values.

Table 4.4: Cronbach's Alpha value of the current study and the adapted study

Construct	No. of items	Current pre-study	Original study	Adapted study
Supplier involvement in NPD	4	0.945	0.860	Chen & Paulraj (2004)
Strategic relationship	4	0.956	0.780	Oke et al. (2013)
Absorptive capacity	4	0.809	0.868	Wagner (2012)
Innovation performance	9	0.917	0.910	Chong et al. (2011)
Supply chain competence	8	0.909	0.915	Roldán Bravo et al. (2016)

4.10.6 Pre-study conclusion

Based on the survey questionnaire that was distributed to the 40 participants, there were no ambiguous directions as they were all clearly articulated. However, some changes, as mentioned in the pre-study analysis section above, were considered, such as the typological mistakes from *fax* to *fast*, modification of the question related to the company's years of experience in the market, and the add-on to the question related to job title, and selection of respondents. All of these changes improved the survey questionnaire's quality.

4.11 Summary

The research methodology framework was explained, including the types of research approach (explanatory, deductive, inductive), and the research philosophy (ontology /objectivism, respectively epistemology/positivism). The reasons for the choice of the specific methodology and methods used in this study were discussed in detail. This research has adopted a cross-sectional approach and the explanation of the sampling frame, techniques, measurement scale, and data collection procedures was presented.

The questionnaire items were adopted from previous studies, the ethical considerations and dissemination pathways were explained in detail. Finally, the results of the conducted pre-study were illustrated at the end of this chapter.

5 Chapter Five: Results and Findings Analysis

The research results and findings analysis chapter outline data assessment by examining missing values, reversing negatively worded items, removing unengaged responses and outliers, assessing demographic data, assessing data normality, and correlation analyses. Moreover, it also discusses exploratory factor analyses, scale validities, and reliabilities. Then, the SEM which consists of two steps: measurement model using CFA and structural model is assessed. Finally, hypotheses testing analyses is conducted.

5.1 Examining Missing Values

Many scholars suggest different tests to get precise results from the regression analysis; checking for missing values is one of them (Hair et al. 2010; Tabachnick & Fidell 2007). Additionally, no missing data were detected since logic checks in the dedicated web-based surveys had been systematically designed to avoid missing data (i.e., respondents were unable to mark the survey as complete until they had answered all questions). As a precautionary measure, in IBM's SPSS software, the Explore technique (Analyse > Descriptive Statistics > Explore) was used to check for any missing data.

5.2 Reversing Negatively Worded Items

According to Pallant (2016), negatively worded items must be reversed to decrease response bias. Positively and negatively worded items were used in questionnaires many decades ago to avoid response bias. Response bias signifies answer patterns in questionnaires which are not reflective of the respondents' actual state or opinion, and hence present a serious threat to the soundness of self-reporting instruments.

Likert scale questionnaires (e.g., strongly disagree, moderately disagree, slightly disagree, neutral, slightly agree, moderately agree, strongly agree) usually include certain items that suit reverse scoring. Reverse scoring implies that the numerical scoring scale runs in the opposite direction. Therefore, *strongly disagree* would draw a score of 1, *moderately disagree* would be 2, *slightly disagree* would be 3, *neutral* still would be 4, *slightly agree* would be 5, and *moderately agree* would be equal 5, whereas *strongly agree* would be 7. In the current research questionnaire, there are no negatively worded items, because the validated scales adopted from the literature did not contain negatively phrased questions.

5.3 Unengaged Responses

A total of 391 out of 860 (45% response rate) completed questionnaires. The response rate appears to be adequate for a managerial-level survey (Devaraj, Krajewski & Wei 2007). According to Awang, Aji, and Osman (2018), the cleaning of data is crucial in enhancing the validity and reliability of the tests performed. Calculation of standard deviations and the establishment of data counts is imperative in evaluating responses. Examining the pattern matrix is an approach favoured in addition to the factor correlation matrix.

Unengaged responses highlight patterns which are suspicious in the respondent's data. Such patterns include similar responses used on different items in a survey (Awang, Aji & Osman 2018); for instance, repetitive responses such as 1111…, 55555…, 12345. Determining unengaged data involves deriving the standard deviation of the obtained data. According to Gaskin (2012), to determine unengaged respondents, a researcher needs to look at standard deviations and data counts. Unengaged responses were detected by calculating the standard deviation for items comprising one variable. Cases in which responses on those items were almost constant, and where standard deviation was equal to zero were excluded. From a total of 391 responses, 22 responses were excluded from the data as their standard deviation was equal to zero.

5.4 Checking for Outliers

Several statistical methods are highly sensitive to outliers, which are data values that fall above or below the majority of all other values in the dataset (Hair et al. 2010). In the present research, outliers were tested to ensure the accuracy of the measurement items and arrive at a suitable model fit; From a total of 369 responses, 18 responses were excluded from the data after conducting the *Z-score* test, that consider them as most extreme outliers. A cut-off value used for finding outliers are *Z-scores* of +3 and -3 (Ronald & Shiffler 1988). Hence, the final sample size is 351 responses from members of the pharmaceutical manufacturing industry.

5.5 Demographic Data

The profile of respondents in the pharmaceutical manufacturing industry in relation to job level and job title, region, number of employee in the company, number of operating years of the sample study, is presented in Table 5.1. As all of the respondents hold middle or senior management positions, it was assumed that they possess sufficient knowledge and experience to evaluate the supply chain collaboration strategies, absorptive capacity, innovation performance, and supply chain competence in their firm.

Table 5.1 shows that among the 351 pharmaceutical companies, 146 (42%) had their headquarters located in Asia, 123 (35%) were located in Europe, 61 (17%) were located in North America, 17 (5%) were located in Africa, and 4 (1%) were located in South America. The number of employees per company in the selected sample was as follows: 44 (13%) had more than 50,001 employees, 89 (25%) had between 5,001, and 50,000 employees. The number of companies with less than 5,000 employees was 218 (62%).

Table 5.1 also shows the company's number of years operating in the market. The sample study shows that 34 (9%) of the companies had been operating in the market for less than three years and 33 (9%) of companies had been operating for between four and six years. Additionally, 19 (5%) of companies had been operational for between seven and nine years. Results showed that 29 (8%) of companies had been operating for between 10 and 12 years, 29 (8%) companies had been operating for between 13 and 15 years, 17 (5%) had been operating for between 16 to 18 years, and 24 (7%) had been operating for between 19 to 21 years. The majority of companies had been operating in the market for over 21 years (53%). The next section explain the descriptive statistic.

Table 5.1: Demographic Data

Job Level	**Frequency**	**Percent**
Operational Manager	69	20%
Middle Manager	106	30%
Senior Manager/Director	176	50%
Job Title	**Frequency**	**Percent**
VP Supply Chain Operation	13	4%
Supply Chain Manager/Director	80	23%
Inventory Manager/Director	2	1%
Logistic and Distribution Manager/Director	10	3%
Procurement Manager/Director	18	5%
Director of Supply Chain Planning	2	1%
Head of Supply Chain Management	18	5%
Key Account Manager	42	12%
Other	166	47%
Region	**Frequency**	**Percent**
Africa	17	5%
Asia	146	42%
Europe	123	35%
North America	61	17%
Oceania	4	1%
South America	17	5%
Number of Employees	**Frequency**	**Percent**
1,000 Employees and less than	148	42%
1,000 - 5,000 Employees	70	20%
5,001 - 10,000 Employees	31	9%
10,001 - 30,000 Employees	41	12%
30,001 - 50,000 Employees	17	5%
More than 50,001 Employees	44	13%
Number of Years	**Frequency**	**Percent**
3 Years and less	30	9%
4 - 6 Years	33	9%
7 - 9 Years	19	5%
10 - 12 Years	29	8%
13 - 15 Years	17	5%
16 - 18 Years	12	3%
19 - 21 Years	24	7%
More than 21 Years	187	53%

5.6 Descriptive Statistic

In many statistical analyses, descriptive statistics analysis is the first analysis that is most frequently performed. This analysis describes the characteristics of the data and also identifies initial evidence of any violations made concerning assumptions of statistical techniques (Leech, Barrett & Morgan 2013). According to Leech, Barrett and Morgan (2013), this analysis also aids in addressing specific questions in the research. In addition, this analysis is vital since most of the statistical tests prove too sensitive with respect to data violations. As such, the descriptive test provides the researcher with clarity about the occurrence of violations; that is, where they are occurring and why they occur. These statistics include the standard deviation and the mean. SPSS provides descriptive statistics for continuous and categorical variables (Argyrous 2011).

This section presents descriptive statistics of study's constructs: Strategic relationship with supply chain partner, supplier involvement in NPD, innovation performance, supply chain competence and absorptive capacity. The survey consists of five constructs which include 29 items on a seven-point Likert scale ranging from *strongly disagree* would draw a score of 1 to *strongly agree* would draw a score of 7 were used to measure these constructs. The results for each item of these construct are reported in Table 5.2. presents descriptive results of these constructs shows that the average mean rating for strategic relationship with supply chain partner (SA1, SA2, SA3, SA3) was 6.03(±1.23); supplier involvement in NPD (INPD1, INPD2, INPD3, INPD4) was 4.47(±1.76); innovation performance (INV1, INV2, INV3, INV4, INV5, INV6, INV7, INV8, INV9) was 5.16(±1.55); supply chain competence (SCC, SCC2, SCC3, SCC4, SCC5, SCC6, SCC7, SCC8) was 5.55(±1.27) and absorptive capacity (ABSC1, ABSC2, ABSC3, ABSC4) was 5.42(±1.24). The next section assess data normality.

Table 5.2: Descriptive statistics of measured items

	N	Minimum	Maximum	Mean	Std. Deviation
SA1	351	1.00	7.00	6.0940	1.22346
SA2	351	1.00	7.00	6.2051	1.20858
SA3	351	1.00	7.00	6.0313	1.12460
SA4	351	1.00	7.00	5.8006	1.38155
INPD1	351	1.00	7.00	4.6724	1.76742
INPD2	351	1.00	7.00	4.6382	1.74278
INPD3	351	1.00	7.00	4.1140	1.84503
INPD4	351	1.00	7.00	4.4872	1.71021
ABSC1	351	1.00	7.00	5.6125	1.15796
ABSC2	351	1.00	7.00	5.2707	1.32588
ABSC3	351	1.00	7.00	5.4900	1.22791
ABSC4	350	1.00	7.00	5.3314	1.25257
INV1	351	1.00	7.00	5.0541	1.60710
INV2	351	1.00	7.00	5.2194	1.51007
INV3	351	1.00	7.00	5.3789	1.45465
INV4	351	1.00	7.00	4.9288	1.64510
INV5	351	1.00	7.00	5.0855	1.61018
INV6	351	1.00	7.00	5.3932	1.53971
INV7	351	1.00	7.00	4.8661	1.60775
INV8	351	1.00	7.00	5.2564	1.44115
INV9	351	1.00	7.00	5.2650	1.54583
SCC1	351	1.00	7.00	5.5613	1.29000
SCC2	351	1.00	7.00	5.2222	1.28360
SCC3	351	1.00	7.00	5.8832	1.18105
SCC4	351	1.00	7.00	5.7692	1.19798
SCC5	351	1.00	7.00	5.4416	1.36962
SCC6	351	1.00	7.00	5.5328	1.34310
SCC7	351	1.00	7.00	5.3732	1.41028
SCC8	351	2.00	7.00	5.6866	1.14334

5.7 Assessing Data Normality

The term *normality* is used to designate the existence of a normal distribution on sample data. According to Hair et al. (2010), normality is the most crucial hypothesis in multivariate analyses and a number of parametric tests. Before deciding to conduct any other statistical tests that are in multivariate analysis, a normality assumption must first be met since most multivariate tests rely on normally distributed data.The degree of normality is tested using two measures: skewness and kurtosis. When the skewness and kurtosis values are zero, the observed distribution is exactly normal, though this is infrequent in social science research (Pallant 2016).

Curran, West and Finch (1996) and Hair et al. (2010) argued that data is considered to be normal if skewness is between -2 to +2 and kurtosis is between -7 to +7. Normality is a critical aspect of making accurate decisions about reality (Field 2009). However, in cases where the sample size is large and comprises more than 30 participants, a failure of data to meet normality assumptions does not lead to critical issues in data analysis (Ghasemi & Zahediasl 2012, Pallant 2016). It is also worth noting that even for non-normally distributed data, parametric analyses can still be carried out if the sample size is large (Elliott & Woodward 2007). It has been noted that even when data do not show normality, distribution is likely to have normal characteristics in sample sizes exceeding 30 (Ghasemi & Zahediasl 2012).

For the present study, normality distribution was assumed because the sample size was large, comprising 351 participants from the pharmaceutical industry. Consequently, even if the normality assumption is violated, it will likely not result in any problem during data analysis, since the sample size exceeds 30 where sampling distributions tend to incline towards normality (Pallant 2016). The present study used skewness and kurtosis values to check normality as shown in Table 5.3 below. The next section discusses the inter-variable correlation test.

Table 5.3: Skewness and kurtosis score of all item's variables.

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
SA1	351	-1.715	0.130	3.245	0.260
SA2	351	-2.041	0.130	4.604	0.260
SA3	351	-1.395	0.130	2.336	0.260
SA4	351	-1.285	0.130	1.369	0.260
INPD1	351	-0.553	0.130	-0.544	0.260
INPD2	351	-0.551	0.130	-0.633	0.260
INPD3	351	-0.300	0.130	-0.977	0.260
INPD4	351	-0.561	0.130	-0.496	0.260
ABSC1	351	-1.025	0.130	1.553	0.260
ABSC2	351	-0.781	0.130	0.280	0.260
ABSC3	351	-0.917	0.130	0.925	0.260
ABSC4	351	-0.792	0.130	0.646	0.260
INV1	351	-0.720	0.130	-0.438	0.260
INV2	351	-0.998	0.130	0.355	0.260
INV3	351	-0.920	0.130	0.368	0.260
INV4	351	-0.656	0.130	-0.399	0.260
INV5	351	-0.858	0.130	0.119	0.260
INV6	351	-1.019	0.130	0.651	0.260
INV7	351	-0.656	0.130	-0.278	0.260
INV8	351	-0.848	0.130	0.354	0.260
INV9	351	-0.968	0.130	0.536	0.260
SCC1	351	-1.084	0.130	1.088	0.260
SCC2	351	-0.715	0.130	0.574	0.260
SCC3	351	-1.143	0.130	1.334	0.260
SCC4	351	-1.242	0.130	1.645	0.260
SCC5	351	-1.008	0.130	0.859	0.260
SCC6	351	-1.045	0.130	0.752	0.260
SCC7	351	-0.830	0.130	0.112	0.260
SCC8	351	-0.783	0.130	0.255	0.260

5.8 Correlation

Correlation is one of the most important methods used to explore relationships between variables. The value of the correlation remains in range of -1 to +1 (Pallant 2016). If the value of the correlation is positive, it is assumed that there is a positive relationship between variables. However, if the correlation value is negative, then it can be said that both variables are inversely related to each other (Pallant 2016). That means if one variable value increases, then the value of another variable will decrease; this is one of the most important approaches used by the data analyst to make decisions.

It is important to note that the correlation coefficient value is always 1 or below, with a plus and minus symbol. The number indicates the magnitude of the relationship between variables and the symbol reflects the direction in which both variables are associated with each other (Pallant 2016). Two variables are assumed to be perfectly correlated where the value of the correlation coefficient is 1. If the value range is between 0.50 to 1, then it is assumed that both variables are highly related to each other. On the other hand, if the correlation value is between 0.30 and 0.50, then there is only a moderate correlation between variables. If the correlation value is less than 0.30, then it is assumed that there is less correlation between variables. If the coefficient is zero, it is concluded that there is no correlation between variables. Finally, if the correlation value is negative and near -1, then there is a highly negative relationship between variables (Pallant 2016).

George and Mallery (2003) identify three categories for the correlation co-efficient value: small, medium, and large, indicating the strength of the association between variables. Table 5.4 shows the results of correlation analyses which were formulated to determine whether there was a relationship between strategic relationship with supply chain partner, supplier involvement in NPD, absorptive capacity, innovation performance, and supply chain competence. Three key features from such a relationship were considered: their strength, direction, and level of significance. According to Pallant (2016), when significant correlations occur between dependent and independent variables, the best results of regression are achieved.

There was a medium positive correlation between strategic relationship with supply chain partner and innovation performance [$r = 0.320$, $n=351$, $p<0.001$], where there is a medium positive correlation between strategic relationship with supply chain partner and supply chain competence [$r=0.332$, $n=351$, $p<0.001$], likewise there is a medium positive correlation between strategic relationship with supply chain partner and supplier involvement in NPD [$r=0.223$, $n=351$, $p<0.001$]. A large positive correlation between strategic relationship with supply chain partner and absorptive capacity exists [$r=0.423$, $n=351$, $p<0.001$].

Results show there is a medium positive correlation between supplier involvement in NPD and innovation performance [$r=0.320$, $n=351$, $p<0.001$]; another medium positive correlation between supplier involvement in NPD and supply chain competence [$r=0.224$, $n=351$, $p<0.001$], as well as absorptive capacity [$r=0.309$, $n=351$, $p<0.001$]. The study shows that the correlation between innovation performance and supply chain competence has a large positive correlation [$r=0.521$, $n=351$, $p<0.001$]. There is also a large positive correlation between innovation performance and absorptive capacity [$r=0.509$, $n=351$, $p<0.001$]. The results of inter-variable correlations have shown that the scale variables were statistically significant and positively correlated to each other.

Table 5.4: Correlations between study constructs

		SA	INPD	ABSC	INV	SCC
SA	Strategic Relationship	1				
INPD	Supplier Involvement in NPD	0.223**	1			
ABSC	Absorptive Capacity	0.423**	0.309**	1		
INV	Innovation Performance	0.320**	0.207**	0.509**	1	
SCC	Supply Chain Competence	0.332**	0.224**	0.478**	0.521**	1

5.9 Multicollinearity and Singularity

When a correlation exists among predictors or independent variables in regression analysis, multicollinearity and singularity may arise (Hair et al. 2010). Specifically, multicollinearity depicts the presence of a correlation of 0.90 or above among variables. On the other hand, the presence of a perfect correlation among variables is described as singularity. When there is singularity and multicollinearity among variables, then logical and statistical problems can arise (Hair et al. 2010). In the current study, there were no singularity and multicollinearity as depicted by the absence of perfect correlation among variables and no highly correlated variables. Multicollinearity occurs when there is a high correlation between two or more predictors in a regression model providing repetitive data about the dependent variable or the response (Hair et al. 2010).

In the present study, the measurement of multicollinearity was accomplished through Variance Inflation Factors (VIF) and tolerance. According to Hair et al. (2010), multicollinearity problems arise when the VIF value is over 4 or when the tolerance does not exceed 0.2. Findings of the implemented collinearity statistical analysis shows that the VIF value was less than 4, showing an absence of multicollinearity, while the tolerance value was more than 0.2, further depicting the absence of multicollinearity problems (Hair et al. 2010).

5.10 Adequacy

To assess sample adequacy, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity test were used to measure the quality of sampling as well as the applicability for factor analysis (Field 2013). If the result of the KMO test is proven to be close to 1.0, then the data is adequate; if it shows between 0.50 and 0.70 then it considered to be good. A score less than 0.50 indicates the sampling is not adequate and that remedial action should be taken (Field 2013). Another test is Barlett's test which was used to check the hypothesis that variables are unrelated. If results show $H_0 > 0.05$ then null hypothesis is accepted and thus is not suitable for factor analysis, and vice versa. The findings in the presented factor analysis suits these data, as the KMO values for the five research latent variables were met. Tables 5.5, 5.6, 5.7, 5.8 and 5.9 show the KMO values were 0.772 for strategic relationship with supply chain partner, 0.797 for supplier involvement in NPD, 0.914 for innovation performance, 0.810 for absorptive capacity, and 0.931 for supply chain competence. The values of Bartlett's test of sphericity were 0.000 ($p<0.001$) for all the five research latent variables.

5.11 Factor Analysis

There are multiple statistical methods for studying the relationships between dependent and independent variables. Still, factor analysis enhances understanding of the relationship patterns among multiple dependent variables while evaluating the features of the independent variables that affect them. Bandalos and Finney (2018) describe factor analysis as a method used for addressing problems through the analysis of the correlation structures among large numbers of variables or items through the definition of large groups with standard underlying dimensions referred to as factors. According to Shi et al. (2020), factor analysis summarizes massive variables and reduces them into smaller components or small variable sets.

Factor analysis is a proper statistical method used for various purposes. Firstly, Shi et al. (2020) show that factor analysis enhances understanding of a theory by explaining the covariation between multiple variables through mapping them to latent constructs. Secondly, Maskey et al. (2018) show that factor analysis helps researchers comprehend the structure of underlying variable sets. According to Maskey et al. (2018) factor analysis enhances this comprehension by enabling researchers to gain insights into various dimensions and allowing construct validation like convergent validity. Thirdly, factor analysis enhances scale development. According to Bandalos and Finney (2018), factor analysis exploits redundancy to improve scale's reliability and validity. Moreover, factor analysis enables the researchers to reduce data or information to smaller and manageable levels. Besides, factor analysis allows the researchers to understand variable structures and construct questionnaires to assess the underlying variables.

The factor analysis' effectiveness necessitates following an effective procedure (Bandalos & Finney 2018). Firstly, researchers identify the latent dimension of the data structure and then find the extent to which each factor explains a variable or the test item. Secondly, the researchers apply the primary uses of the factor analysis (summarisation and reduction). The summarisation and reduction of data may be achieved through the CFA method or the EFA method. According to

Bandalos and Finney (2018), CFA combines multiple variables on specific factors set of a single factor to test a hypothesis.

On the other hand, EFA describes a phenomenon by applying the "take what the data gives you" technique (Bandalos & Finney 2018). According to Maskey et al. (2018), the EFA does not consider any hypothesis. Shi et al. (2020) argue that EFA is an investigative process used by researchers to enhance an understanding of the existing associations between the initial variables and improves the comprehension of where each of the variables lies or where it can be grouped.

In this study, the researcher started by conducting EFA to examine each construct's (herein referred to as factor) and then a CFA to test and confirm the relationships among the observed variables in every hypothesised construct. The subsequent sections describe EFA that uses the SPSS version 23.0.

5.12 Exploratory Factor Analysis

As mentioned earlier, EFA seeks to understand the relationship between multiple variables. Shi et al. (2020) define EFA as " a multivariate statistical technique that analyses data on a relatively large set of variables and produces a smaller set of factors, which are linear combinations of the original variables, so that the set of factors captures much information as possible from the data set." Bandalos and Finney (2018) show that many researchers have used EFA to select a large pool of variables or items, group them in manageable forms, and assess the relationships among variables without any prior hypothesis.

An EFA involves two main steps; Extraction and rotation. According to Shi et al. (2020), the extraction process determines various factors underlying multiple variables. Bandalos and Finney (2018) show numerous extraction methods, although the commonly used method is the principal component analysis method. According to Maskey et al. (2018), the principal component analysis method is popular for its reliable analysis of the variables without errors. The rotation is the second step when conducting the EFA. The step seeks to present variable patterns in a form that is easy to interpret. According to Shi et al. (2020), there are two main approaches to rotation; oblique and orthogonal rotation methods. According to Bandalos and Finney (2018), the oblique rotation method assumes a correlation between the extracted variables, while the orthogonal extraction method assumes that they are independent (uncorrelated).

This study, applied the principal component analysis and orthogonal rotation model with varimax rotation to conduct a factor analysis using the SPSS (version 23.0) for each of the study constructs. The primary rationale for using the orthogonal rotation model is the higher replicability and generalization of its results than the oblique method.

Following the application of factor analysis and data reduction to the strategic relationship with supply chain partner four items factors are reduced to a single component. Table 5.5 shows that strategic relationship with supply chain partner represents 63.913% of the total variance explained and is made up of four items. A good rule is that the communality for each variable is considered acceptable if it is greater than 0.40 (Costello & Osborne 2005). This means that the derived factors explain at least half of each original variable's variance. shows that all the items have communality exceeding 0.4 range from 0.582 to 0.679. It also shows factor loadings for each variable, the factor loading test results revealed that all items exceeded the acceptable values of 0.50, as per Hair et al.

(2010). The items factor loading were laid on the range of 0.763 to 0.824 that showed in the Table 5.5, factors SA1, SA2, SA3 and SA4 exert a higher effect on a single component. The same procedure is replicated for all the other factors.

Table 5.5: Factor analysis for strategic relationship

Research construct	Rotation sum of squared loadings: variance %	Extracted eigenvalue	KMO	Factor code	Factor loading	Communalities
Strategic Relationship	63.913	2.557	0.772	SA1	0.794	0.631
				SA2	0.824	0.679
				SA3	0.815	0.664
				SA4	0.763	0.582

Supplier involvement in NPD factors, the four items factors reduced to a single component. As can be noted from Table 5.6, Supplier involvement in NPD represents 72.136% of the total variance explained and comprises four items. A good rule is that the communality for each variable is considered acceptable if it is greater than 0.40 (Costello & Osborne 2005). This means that the derived factors explain at least half of each original variable's variance. Table 5.6 shows that all the items have communality exceeding 0.4 range from 0.699 to 0.757. It also shows factor loadings for each variable. The factor loading test results revealed that all items exceeded the acceptable values of 0.50, as per Hair et al. (2010). As shown in table 5.6, the factor loadings of the items lay between 0.821 and 0.870, factors INPD1, INPD2, INPD3 and INPD4 have greater influence on the component.

Table 5.6: Factor analysis for supplier involvement in NPD

Research construct	Rotation sum of squared loadings: variance %	Extracted eigenvalue	KMO	Factor code	Factor loading	Communalities
Supplier Involvement in NPD	72.136	2.885	0.797	INPD1	0.836	0.699
				INPD2	0.821	0.673
				INPD3	0.870	0.757
				INPD4	0.869	0.755

Following the same, applying factor analysis that define innovation performance, the nine factors of the questionnaire were reduced to a single component. As depicted in Table 5.7, innovation performance comprises nine items, representing 59.278% of the total variance explained. A good rule is that the communality for each variable is considered acceptable if it is greater than 0.40 (Costello & Osborne 2005). This means that the derived factors explain at least half of each original variable's variance. Table 5.7 shows that all the items have communality exceeding 0.40 except item number 6. Though, the loading was 0.398, which is quite near to the acceptable value of 0.40, and the communality varies between 0.398 and 0.706. The factor loadings for each variable are also shown. The factor loading test results revealed that all items exceeded the acceptable values of 0.50, as per Hair et al. (2010). As shown in Table 5.7, the factor loadings of the items lay in the 0.631 – 0.840 range, factors INV1, INV2, INV3, INV4, INV5, INV6, INV7, INV8 and INV9 exert a higher effect on the component.

Table 5.7: Factor analysis for innovation performance

Research construct	Rotation sum of squared loadings: variance %	Extracted eigenvalue	KMO	Factor code	Factor loading	Communalities
Innovation Performance	59.278	5.335	0.914	INV1	0.823	0.678
				INV2	0.817	0.667
				INV3	0.840	0.706
				INV4	0.796	0.633
				INV5	0.718	0.515
				INV6	0.631	0.398
				INV7	0.761	0.579
				INV8	0.831	0.691
				INV9	0.683	0.467

Upon application of factor analysis to the supply chain competence factors, the eight factors in the questionnaire come down to a single component. As can be seen in Table 5.8, Supply chain competence comprises eight items, which represents 60.722% of the total variance explained. A good rule is that the communality for each variable is considered acceptable if it is greater than 0.40 (Costello & Osborne 2005). This means that the derived factors explain at least half of each original variable's variance. Table 5.8 shows that all the items have communality exceeding 0.4 ranges from 0.468 to 0.708. It also shows factor loadings for each variable. The factor loading test results revealed that all items exceeded the acceptable values of 0.50, as per Hair et al. (2010). As depicted in Table 5.8, the factor loadings of the items lay in the 0.684 – 0.841 range, and factors SCC1, SCC2, SCC3, SCC4, SCC5, SCC6, SCC7 and SCC8 have greater influence on the component.

Table 5.8: Factor analysis for supply chain competence

Research construct	Rotation sum of squared loadings: variance %	Extracted eigenvalue	KMO	Factor code	Factor loading	Communalities
Supply Chain Competence	60.722	4.858	0.917	SCC1	0.813	0.661
				SCC2	0.684	0.468
				SCC3	0.729	0.531
				SCC4	0.811	0.658
				SCC5	0.768	0.590
				SCC6	0.841	0.708
				SCC7	0.782	0.612
				SCC8	0.794	0.631

Lastly, absorptive capacity factors reduced the four factors to a single component. As presented in Table 5.9, absorptive capacity comprises four items, representing 71.478% of the total variance explained. A good rule is that the communality for each variable is considered acceptable if it is greater than 0.40 (Costello & Osborne 2005). This means that the derived factors explain at least half of each original variable's variance. Table 5.9 shows that all the items have communality exceeding 0.4 ranges from 0.669 to 0.819. It also shows factor loadings for each variable. The factor loading test results revealed that all items exceeded the acceptable values of 0.50, as per Hair et al. (2010). As can be seen in Table 5.9, the factor loadings of the items lay in the 0.818 – 0.905 range, and factors ABSC1, ABSC2, ABSC3 and ABSC4 have exert a higher effect on the component.

Table 5.9: Factor analysis for absorptive capacity

Research construct	Rotation sum of squared loadings: variance %	Extracted eigenvalue	KMO	Factor code	Factor loading	Communalities
Absorptive Capacity	71.478	2.859	0.810	ABSC1	0.830	0.689
				ABSC2	0.826	0.682
				ABSC3	0.905	0.819
				ABSC4	0.818	0.669

5.13 Measuring the Reliability

The idea of reliability refers to the measuring items consistency across different instruments and times Huck (2004). Additionally, reliability considers as the degree to which an independent measure of the same latent variable yields the same results thru different versions of the instrument, times, or groups of people (Vanderstoep & Johnston 2009). To test the measurements reliability, the current study employed Cronbach's coefficient alpha and Composite reliability.

5.13.1 Cronbach's alpha

For any latent construct, it is important to evaluate the construct's internal consistencies (or scale reliability). Scale reliability, referred to as the fraction of the variation which can be attributed to the true latent construct score (Pallant 2016), is the degree to which a latent construct leads to similar measurements upon repeated data collection (Seo et al. 2004). A widely used measure of scale reliability is Cronbach's alpha, which measures the internal consistency of a latent construct. The measure of Cronbach's alpha ranges between 0 and 1, a higher value indicating a more stable latent construct (Pallant 2016). In general, as suggested in Pallant (2016), 0.70 is a minimum accepted a Cronbach's alpha value for the reliability. Table 5.10, in the following, presents the measures of internal consistency for the latent constructs (Cronbach's alpha). Once the latent constructs exhibited a satisfactory reliability measure, the latent construct scores were obtained by averaging the individual responses on the items under the respective latent constructs.

Cronbach's alpha measurements for all five latent constructs in this study were found to be fairly high, ranging from a minimum of 0.807 (for SA) to a maximum of 0.912 (for INV). The high values of Cronbach's alpha suggested that all five scales can be used in further statistical analyses as all of them have satisfactory reliability results.

5.13.2 Composite Reliability

For each variable the manual formula (∑standardized loading) 2 / (∑standardized loading) 2 + ∑ measurement errors are used to calculate the composite reliability. Hair et al. (2010) recommended score of 0.7 and above threshold value for composite reliability coefficients. Previous studies contended that a CR value of 0.7 and more signifies a satisfactory level of internal reliability (Hair et al. 2010; Kline 2015; Nunnally & Bernstein 1994). Results show that all variables composite reliability coefficients exceeded the values for recommended criteria used in previous researches by Hair et al. (2010); Kline (2015); Nunnally and Bernstein (1994). Hence, all the study five variables composite reliability coefficients values indicate that they are highly reliable.

Composite reliability and Cronbach's alpha analysis are shown in Table 5.10 below. Composite reliability with value >0.9 specifies a high internal consistence reliability, that are still desirable (Hair et al. 2010). Values over 0.9 are acceptable while there is no repetitive items in the scale, because they reinforce that the construct is unidimensional (Hair et al. 2010).

Table 5.10: Cronbach's alpha and Composite reliability

Construct	**Cronbach's alpha**	**Composite Reliability**
Threshold for Acceptable Fit	≥0.70	≥0.70
Strategic relationship	0.807	0.876
Supplier Involvement in NPD	0.871	0.912
Absorptive Capacity	0.865	0.909
Innovation Performance	0.912	0.929
Supply Chain Competence	0.906	0.925

5.14 Test of Common Method Bias

According to Saiyidi, common method bias arises when the instrument triggers variations in responses rather than the respondents underlying predispositions that the device seeks to uncover. In other words, an instrument creates a bias (2016). According to Podsakoff et al. (2003) common method variance is indeed an issue, and analysts need to do whatever they can to regulate this by carefully reviewing the research environment to identify possible bias sources and incorporate both statistical and procedural control mechanisms (p. 900). The purpose of testing for common method variance is to analyse to what extent any such biases occur. Analysis methods evaluate the degree to which the survey method or tool's prejudices can influence the data (p. 879).

Harman’s single-factor test refers to a method used by researchers to examine the issue of common method variance. Past practices involving Harman’s single factor included the loading of all variables related to a research study on EFA, followed by an examination of the unrotated factor solution to define the number of factors needed to justify the observed variance in the variables (Podsakoff & Organ 1986). Two basic assumptions should be met when using Harman’s single factor test. This technique assumes that if there is a significant degree of common method variance, then either there will be an emergence of a single factor in the factor analysis (Mossholder et al. 1998), or one common factor will be attributed to most of the co-variance among the measures (Korsgaard & Roberson 1995).

Harman’s single-factor test is still widely used by authors publishing in top business journals (Podsakoff et al. 2003), yet the common latent factor technique and common marker variable are other techniques that are used to test common method bias. The common latent factor technique implements a new latent variable so that all manifested variables are connected to it, those ways are bound to be equivalent, and the variance of the common factor is bound to be 1 (Eichhorn 2014, p. 5). This technique establishes a common latent factor to obtain the common variance across all observable variables in the method.

The researcher used Harman’s single-factor method to examine common method bias and ran a factor analysis with no rotation and one factor to be extracted, as shown in Table 5.11. The first factor explains 31.903% of total variance, indicating that there is no concern for the common method bias threshold: 50%; since 31.903<50% is not problematic

Table 5.11: Harman single-factor test

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.880	34.068	34.068	9.252	31.903	31.903
2	2.819	9.721	43.789			
3	2.498	8.615	52.405			
4	2.146	7.399	59.804			
5	1.488	5.130	64.934			
6	0.941	3.244	68.178			
7	0.803	2.770	70.949			
8	0.709	2.445	73.393			
9	0.631	2.175	75.568			
10	0.578	1.993	77.562			
11	0.564	1.947	79.508			
12	0.547	1.886	81.394			
13	0.481	1.660	83.054			
14	0.473	1.632	84.686			
15	0.441	1.521	86.207			
16	0.387	1.335	87.542			
17	0.377	1.300	88.843			
18	0.370	1.275	90.117			
19	0.360	1.241	91.359			
20	0.347	1.197	92.555			
21	0.327	1.126	93.681			
22	0.287	0.991	94.673			
23	0.267	0.921	95.594			
24	0.254	0.874	96.468			
25	0.241	0.831	97.299			
26	0.231	0.797	98.096			
27	0.211	0.729	98.825			
28	0.176	0.607	99.432			
29	0.165	0.568	100.000			

Extraction Method: Principal Component Analysis.

5.15 Structural Equation Modelling Analysis: Measurement Model

Measurement model performed to explain the interconnections between observed and unobserved variables. It aims to check which indicator variables relate to the each of its corresponding underlying latent variable. Hence, to find the pattern in which indicator variables were loaded onto a given latent variable, measurement model was applied (Kline 2015; Hair et al. 2010). AMOS' ML estimation technique was used to assess the measurement model (Hair et al. 2010; Tabachnick & Fidell 2007). This estimation technique was chosen because: (i) it is apt when working with medium-sized samples; (ii) it is apt if the model has fewer than five indicator variables (items) per latent variable (Anderson & Gerbing 1988; Hair et. al. 2010) (note that some of the latent variables in the present study have fewer than five indicator variables); (iii) the ML estimation technique is unbiased when there is a moderate violation of normality, unlike other estimation methods (Kline 2015); and finally, (iv) SEM is one of the most commonly used ML estimator technique for analysis (Kline 2015; Tabachnick & Fidell 2007) because it decreases the difference between the observed and covariance matrices, thereby improving the estimates obtained for the various parameters (Hair et al. 2010). Thus, this study follows the recommendations by other researchers (Anderson & Gerbing, 1988; Hair et al. 2010; Kline 2015) and runs the measurement model using the ML estimation technique.

5.15.1 Confirmatory Factor Analysis

Before proceeding to the analyses of hypotheses testing, another investigation of the qualities of the latent construct scores was performed using the data on individual items. This analysis was conducted to assess the suitability of theoretical factor structures for five constructs, namely strategic relationship with supply chain partner, supplier involvement in NPD, absorptive capacity, innovation performance, and supply chain competence. IBM SPSS AMOS 23 has been used to test the CFA models. To assess goodness of fit for the CFA models, the researcher used very well-known and widely used measures, such as CMIN/DF with a range from < 3.00 (Byrne 2001); CFI ≥ 0.9 (Kline 2015); NFI ≥ 0.80 (Ullman 2001); IFI ≥ 0.80 (Garson 2015); the TLI with a range from 0 to 1 (Kline 2015); RFI ≥ 0.80 (Garson 2015); RMR ≤ 0.08 (Reisinger & Mavondo 2007, p.57) and RMSEA ≤ 0.08 (MacCallum, Browne & Sugawara 1996). These indices were chosen from the many existing indices since they are the least sensitive to model misspecification, sample size, and parameter estimates. The relationships between the items and the constructs must be tested in order to verify the construct's validity. The models should have substantial standardized loadings, note that for the model to be acceptable standardized loadings should be greater than 0.50 (Janssens et al. 2008, p.294), besides those greater than 0.70 are considered to be ideal (Hair et al. 2010, p.708). In the present study, two techniques were used to run CFA for the measurement model in SEM: individual and pooled CFA. In individual CFA, each latent variable involved in the study is run separately, while in pooled CFA, all the latent variables of the study are run simultaneously (Zainudin 2012).

First, the CFA method was used for the individual latent constructs to test the unidimensionality and validity of its measurement model (Awang 2015). In statistics, unidimensionality is referred to as a concept used to explain measuring particular constructs (Riegel 2018 p. 3). The constructs in question are measured and analysed based on the difference of a common source variable. A unidimensional scale means that it informs the measurement of a single trait in constructs under a statically study (Ziegler 2015 p. 231). Thus, the items or constructs vary alongside one common measurement variable, and hence it informs the scale as a means that measures a single common statistical trait.

The CFA models for the individual constructs are presented in Figures 5.1, 5.2, 5.3, 5.4 and 5.5. The CFA figures also present the estimated standardized regression coefficients. When analysing strategic relationship with supply chain partner, the initial fit statistics of this model were satisfactory, as shown in Figure 5.1. Regarding supplier involvement in NPD, the initial fit statistics of this construct were not satisfactory. Based on larger modified indices, the covariances between residuals for items 1 and 2 were examined and are shown in Figure 5.2. This improved the model fit statistics to a satisfactory level. Figures 5.2 shows the final fitted model and Table 5.12 presents the fit statistics with their satisfactory levels recommended in the literature. For absorptive capacity the initial fit statistics of this model were satisfactory. Figure 5.3 shows the fitted model and Table 5.12 presents the fit statistics with their satisfactory levels recommended in the literature.

Moreover, innovation performance the initial fit statistics of this construct were not satisfactory. Based on larger modified indices, we decided to consider the covariances between residuals for items 1 and 2, 2 and 3, 5 and 7 (see Figure 5.4). For further improvement in fit, we observed the standardized residual covariances and factor weights of the items under each factor and based on higher residual covariance and smaller factor weights we dropped a questionnaire item (item 6) from analysis. This improved the model fit statistics to satisfactory level. Figure 5.4 shows the final fitted model and Table 5.12 presents the fit statistics with their satisfactory levels recommended in literature.

Supply chain competence initial fit statistics of this construct were not satisfactory. Based on larger modified indices, the covariances between residuals were considered for items 1 and 7; 3 and 4 (see Figure 5.5). This improved the model fit statistics to a satisfactory level. Figure 5.5 shows the final fitted model and Table 5.12 presents the fit statistics with their satisfactory levels recommended in the literature.

Table 5.12: The goodness of fit statistics of the individual CFA

Goodness of fit index	Recommended level	Result
Strategic Relationship (SA)		
Chi Square Test	-	χ^2 = 2.113/1, p=0.146
CMIN/DF	< 3.00 (Byrne 2011)	2.113
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	0.998
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	0.995
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	0.998
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	0.985
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	0.973
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.010
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996)	0.056
Supplier Involvement in NPD (INPD)		
Chi Square Test	-	χ^2= 0.019/1, p= 0.890
CMIN/DF	< 3.00 (Byrne 2011)	1.000
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	1.000
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	1.000
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	1.000
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	1.000
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	1.000
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.000
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996))	0.000
Absorptive Capacity (ABSC)		
Chi Square Test	-	χ^2 = 3.948/2, p=0.139
CMIN/DF	< 3.00 (Byrne 2011)	1.974
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	0.997
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	0.994
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	0.997
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	0.991
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	0.983
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.014
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996)	0.053
Innovation Performance (INV)		
Chi Square Test	-	χ^2 = 47.142/17, p=0.000
CMIN/DF	< 3.00 (Byrne 2011)	2.773
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	0.983
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	0.973
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	0.983
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	0.971
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	0.956
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.028
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996)	0.071
Supply Chain Competence (SCC)		
Chi Square Test	-	χ^2 =40.597/18, p= 0.002
CMIN/DF	< 3.00 (Byrne 2011)	2.225
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	0.985
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	0.974
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	0.985
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	0.977
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	0.959
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.027
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996)	0.060

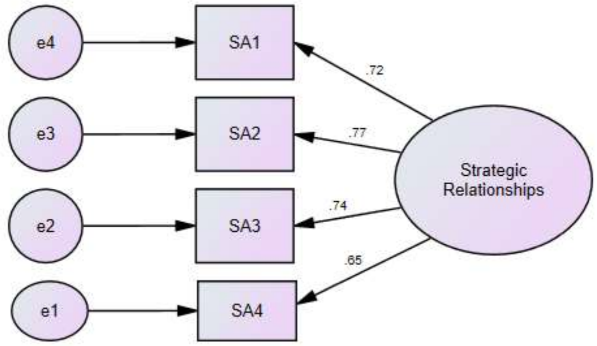


Figure 5.1: Strategic relationship

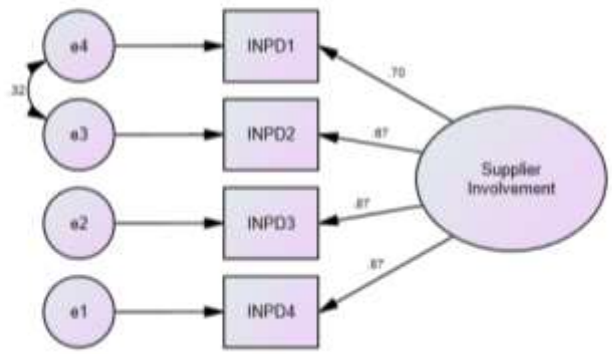


Figure 5.2: Supplier involvement in NPD

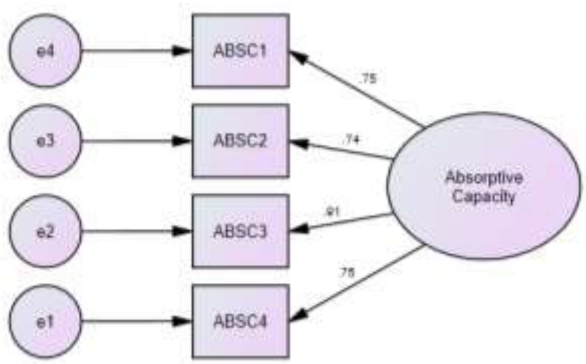


Figure 5.3: Absorptive capacity

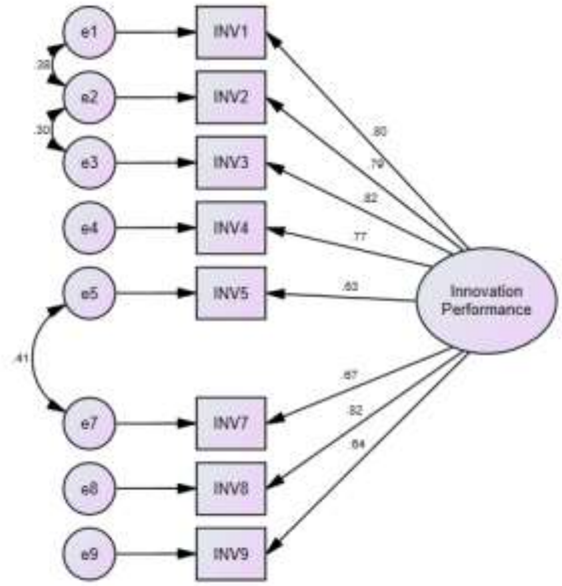


Figure 5.4: Innovation performance

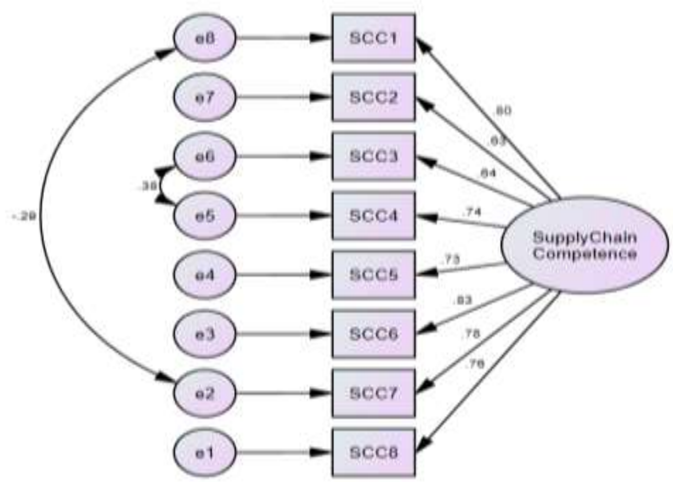


Figure 5.5: Supply chain competence

Secondly, the researcher conducted analyses for all constructs together (pooled CFA) as shown in Figure 5.6 with goodness of fit indicators. This method considered as highly suggested and efficient and method for assessing the measurement model. Pooled CFA combines all the study constructs in one measurement model and perform the analysis all at once. For this study in Figure 5.6 shows the measurement model and Table 5.13 shows the results of model identification which referred as an over-identified model as the results show that the df > 0. According to Byrne (2016, p. 42) over-identified model consider to be appropriate for "scientific use" as we can examine the global fit statistics to assess overall model fit. Results show that the model fit is within the satisfactory level but a further enhancement to the model is considered. Based on some modified indices, the researcher decided to consider the covariances between residuals for items INV5 and INV7 (innovation performance) in Figure 5.6. This improved the model fit statistics to a more satisfactory level. Figure 5.6 shows the final fitted model and Table 5.13 presents the fit statistics with their satisfactory levels recommended in literature. These modifications improved the model fit considerably. Once a well-fitted measurement model is obtained, the structural model can be used to estimate the relationships between latent scales.

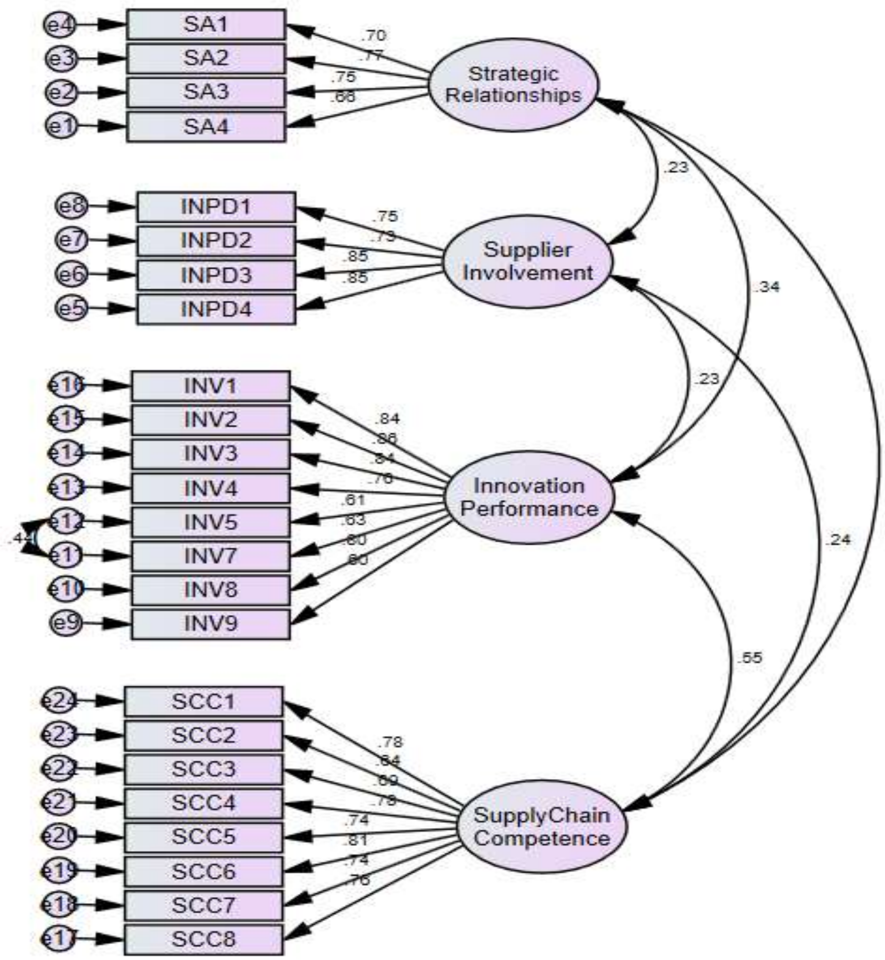


Figure 5.6: Measurement model

Table 5.13: The goodness of fit statistics of the pooled CFA

Goodness of fit index	Recommended level	Measurement Model
Chi Square Test	-	$\chi^2 = 566.588$, $p < 0.000$
CMIN/DF	< 3.00 (Byrne 2011)	2.313
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	0.932
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	0.903
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	0.932
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	0.923
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	0.872
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.052
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996)	0.061

5.16 Measuring Construct Validity

Validity is described by Vanderstoep and Johnston (2009) as a measurement of accuracy and truthfulness, which indicates if an observed variable actually measures the intended unobserved variable in a given context. In this study, the researcher only tested and discussed construct since it is suitable to the purpose of the study.

Construct validity aims to ensure that the instrument used truly measures and evaluates the construct (s) it was designed to assess/measure. Construct validity is when a researcher finds a high correlation with other research that measures a similar construct (Colliver et al. 2012). Construct validity is used because it ensures that the theoretical construct or concept that the researcher wants to measure has been precisely defined in advance (Kane 2012). Construct validity is, therefore, a prerequisite for content validity, because only if the construct is precisely determined is it possible to measure it correctly. Construct validity is also used because it expresses the requirement that the manifestations and behaviours observed during an evaluation or measurement process are really, and adequately, related to the underlying entity that the researcher is trying to capture (Kane 2012). Since it is necessary to ensure that the theoretical "construct" in which one is interested is suitably operationalized by the components of the instrument or device used, construct validity makes this possible. Moreover, construct validity functions as a prerequisite for content validity and represents the overlap of indicators and the construct to be measured. In the desired case of high construct validity, there should be a high correlation with tests intended to measure the same construct (Kane 2012). There should be a low correlation with tests that are supposed to capture a completely different construct (Nájera Catalán & Gordon 2020).

Lastly, construct validity testifies that the research methodology instrument or questionnaire used is a real measuring instrument (Kane 2012). It establishes the empirical validity and reliability of the scale against another existing questionnaire considered to be the benchmark (Colliver et al. 2012). This study used construct validity, which are: convergent, discriminant and nomological validity.

5.16.1 Convergent Validity

Three principles recommended by Fornell and Larcker (1981) to test convergent validity were used to evaluate the study constructs: first, all measurement factor loadings must be substantial and over 0.70, however 0.50 or more is still adequate (Hair et al. 2010); second, construct reliabilities must be over 0.80 and; third, AVE should be over 0.50 as each construct must surpass the variance due to that construct's measurement error.

Factor analysis was carried out to check the convergent validity for five constructs: strategic relationship, supplier involvement in NPD, absorptive capacity, innovation performance, and supply chain competence, which included all questionnaires that were used to obtain answers from supply chain professionals in the pharmaceutical industry. Each factor was calculated manually using the AVE formula recommended by Hair et al. (2010) as follows: AVE=Sum of squared loadings/sum of squared standardized loadings + sum of error variance (p.17). Table 5.14 shows that the convergent validity attained as AVE values exceeded 0.5 (Fornell & Larcker 1981).

5.16.2 Discriminant Validity

A construct's discriminant validity is tested through a comparison between its shared variance (SV) and AVE values (Fornell & Larcker 1981; Hair et al. 2010). The discriminant validity of all studied constructs was tested by comparing their SV and AVE values. The AVE (in bold below) for all constructs' values was higher than SV values as shown in Table 5.14. Therefore, discriminant validity was achieved. Also, the factors present adequate discriminant validity as the correlation matrix has not shown any correlations over 0.7. The next section discusses the nomological validity.

Table 5.14: Convergent and discriminate validity test amongst constructs

Component	AVE	INV	SCC	INPD	SA	ABSC
Threshold	≥0.50					
INV	0.593	**0.593**				
SCC	0.607	0.521	**0.607**			
INPD	0.721	0.207	0.224	**0.721**		
SA	0.639	0.320	0.332	0.223	**0.639**	
ABSC	0.715	0.509	0.478	0.309	0.423	**0.715**

5.16.3 Nomological Validity

Nomological validity is the ability to examine the constructs correlations degree in the measurement model (Hair et. al. 2010). The researcher expected a positive relationship between the constructs, as far as there are existing of well-grounded theoretical reasons. In the current study, Nomological validity would be confirmed if the scores for the strategic relationship between supply chain partner, supplier involvement in NPD, and absorptive capacity were significantly correlated with innovation performance and supply chain competence. As well as, there is a significant correlation between supply chain competence and innovation performance. Measurement of the nomological validity of the study constructs was conducted using the measurement model depicted in Figure 5.6. Results in Tables 5.15 and 5.16 revealed that the correlations in the theoretical model were significant and positive which support the nomological validity (Hair et. al. 2010).

Table 5.15: AMOS output – Covariances

			Estimate
Strategic Relationship	<->	Innovation Performance	0.339
Strategic Relationship	<->	Supply Chain Competence	0.388
Supplier Involvement	<->	Innovation Performance	0.235
Supplier Involvement	<->	Supply Chain Competence	0.245
Innovation Performance	<->	Supply Chain Competence	0.553

Table 5.16: AMOS output - Construct Correlations

			Estimate	S. E	C.R	p
Strategic Relationship	<->	Innovation Performance	0.290	0.061	4.720	***
Strategic Relationship	<->	Supply Chain Competence	0.308	0.057	5.392	***
Supplier Involvement	<->	Innovation Performance	0.317	0.085	3.712	***
Supplier Involvement	<->	Supply Chain Competence	0.305	0.078	3.897	***
Innovation Performance	<->	Supply Chain Competence	0.446	0.065	6.874	***

5.17 Structural Equation Modelling Analysis: Structural Model

This analysis was conducted using IBM's SPSS and AMOS 23 software in order to fulfil the study objectives outlined in Chapter One. The model is specified based on hypothesised theory in order to pursue the main objectives of this research. The basic structural model is demonstrated in Figure 5.7 using fundamental concepts for the relationship between constructs (see Figure 3.1 in Chapter 3). The main goal of this statistical analysis was to examine the associations between strategic relationship with supply chain partner, supplier involvement in NPD, absorptive capacity, supply chain competence, and innovation performance. More specifically, this is the direct relationship between variables and the mediation impact of supply chain competence on the relationship between supply chain collaboration strategies and innovation performance, as well as the moderation effect of absorptive capacity on the relationships between supply chain collaboration strategies and innovation performance which need to be evaluated.

A SEM approach has been utilized for this aim. Theoretically, any SEM comprises two components: a measurement model and a structural model. The measurement model assesses how well the observed items measure the latent scales, while the structural model estimates the relationships between the latent scales (Wong & Cheung 2005). Proposed hypotheses were tested in two interlinked stages. The first stage involved investigating the direct and mediation relationship hypotheses 1, 2, 3, 4, 5, 6 and 7. The second stage involved testing moderation hypotheses 8 and 9.

5.17.1 Examining the Direct and Mediation Effect

The research questions posted on Chapter One had been posed to examine direct and mediation relationships in order to understand the technique through which the independent variable influences the dependent variable, and the role of the mediator on the relationship. Hypotheses tested, as shown in Figure 5.7, was carried out through inspecting the relevant significance of both the direct and indirect effects. As illustrated on Table 5.17, the overall goodness of fit for the model seems to be acceptable (normed χ^2: 2.217; RMSEA: 0.059; RMR: 0.0528; CFI: 0.937; and TLI: 0.929).

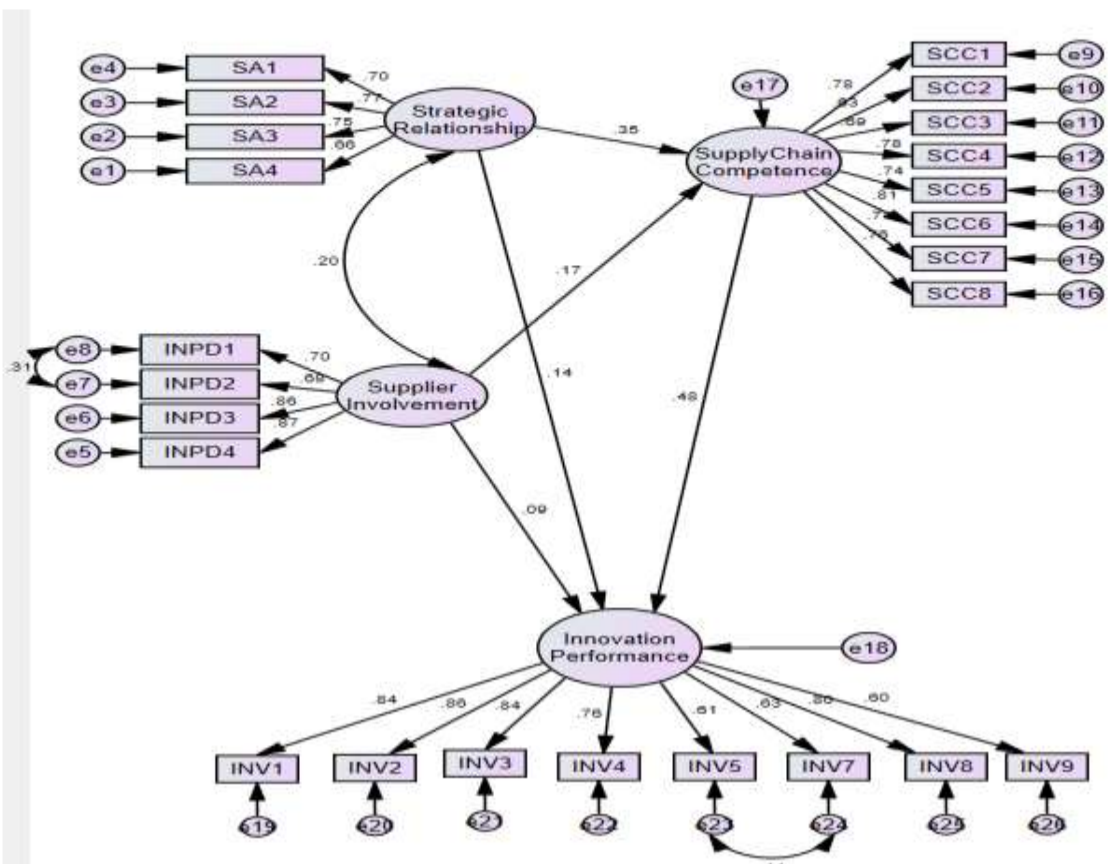


Figure 5.7: Mediation structural model

Table 5.17: The goodness of fit statistics of the structural model

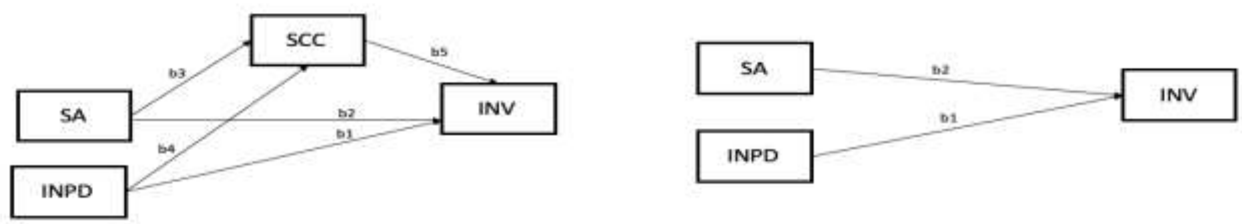
Goodness of Fit Index	Recommended Level	Structural Model
Chi Square Test	-	χ^2 =540.918/244,p<0.000
CMIN/DF	< 3.00 (Byrne 2011)	2.217
Comparative Fit Index (CFI)	> 0.90 (Kline 2015)	0.937
Normed Fit Index (NFI)	> 0.80 (Ullman 2001)	0.891
Incremental Fit Index (IFI)	> 0.80 (Garson 2015)	0.937
The Tucker-Lewis Index (TLI)	> 0.90 (Kline 2015)	0.929
Relative Fit Index (RFI)	> 0.80 (Garson 2015)	0.877
Root Mean Square Residual (RMR)	< 0.08 (Reisinger & Mavondo 2007)	0.052
Root Mean Square Error of Approximation (RMSEA)	< 0.08 (MacCallum et al. 1996)	0.059

According to Lachowicz, Preacher and Kelley (2018), there are four steps to be followed in establishing mediation, and it is a well-known approach used by Baron and Kenny (1986). Emphasizing the regression equation in connection to the independent variable, dependent variable, and mediator variable is illustrated in Table 5.18. In the first step, the casual variable relates to the outcome variable and determines that there is an effect which might be mediated. The second step reflects on the relationship of the casual variable with the mediator where the mediation effect has been identified. The third step shows the relationship between the outcome variable and the mediator. In the last step, the casual variable does not relate to the outcome variable where the results generated from mediation effect have been shown. Complying with the three steps reveals partial mediation while fulfilling all four steps shows full mediation (Baron & Kenny 1986).

Table 5.18:Steps of the Baron-and-Kenny (own illustrated based on Müller 2009, p. 247)

Steps	Tasted path	Regression equation
Step 1	Path b_1 & b_2 **Total Effect of X on Y**	$\widehat{INV} = b_0 + \boldsymbol{b_1 X_{inpd}} + \boldsymbol{b_2 X_{sa}}$
Step 2	Path b_3 & b_4 **Effect of X on M**	$\widehat{SCC} = b_0 + \boldsymbol{b_3 X_{inpd}} + \boldsymbol{b_4 X_{sa}}$
Step 3	Path b_5 **Effect of M on Y**	$\widehat{INV} = b_0 + b_1 X_{inpd} + b_2 X_{sa} + \boldsymbol{b_5} M_{scc}$
Step 4	Path b_1 & b_2 **Direct effect of X on Y**	$\widehat{INV} = b_0 + b_5 M_{scc} + \boldsymbol{b_1 X_{inpd}} + \boldsymbol{b_2 X_{sa}}$

Visualisation



SA: Strategic Relationship with Supply Chain Partner; INPD: Supplier Involvement in NPD; SCC: Supply Chain Competence; INV: Innovation Performance

SEM tools have been gradually replaced with a traditional approach for the purpose of testing mediation between constructs (Ismail 2017). Thus, bootstrapping was considered to examine the direct and indirect effects between the constructs.

Furthermore, according to Preacher and Hayes (2004) bootstrapping method offers point estimates and confidence intervals that can be used to confirm whether or not a mediation effect is significant. Point estimates are means taken over several bootstrapped samples and if zero does not lie in the confidence intervals provided by the bootstrapping method, one can confidently conclude that there is a significant mediation effect to report. The proposed relationships between the supply chain collaboration strategies and innovation performance, with the mediation impact of supply chain competence, were examined using AMOS 23.0 and specific indirect effects for the model were calculated using AMOS user-defined estimands (Gaskin 2012). To investigate the relationships, a structural analysis was conducted. The structural model is presented in Figure 5.7 along with the standardised regression coefficients.

The standardised direct, indirect, and total effect estimates from the structural model are presented in Table 5.19. The results give support to H_1**:** Strategic relationship with supply chain partner is positively related to innovation performance; The results indicated that the relationship is positive and significant (β=0.202, p<0.05) which reinforces the hypothesis. H_2**:** Supplier involvement in NPD is positively related to innovation performance; the results indicated that the relationship is non-significant (β=0.078, p>0.05 ns). H_3**:** Strategic relationship with supply chain partner is positively related to supply chain competence; the results indicated that the relationship is positive and significant (β=0.389, p<0.001) which reinforces the hypothesis. As well giving support to H_4**:** supplier involvement in NPD is positively related to supply chain competence. The results indicated that the relationship is positive and significant (β=0.114, p<0.01) which reinforces the hypothesis. Additionally, giving support to H_5: Supply chain competence is positively related to innovation performance, meaning: The results demonstrated that the relationship is positive and significant (β=0.647, p<.001), which reinforces the hypothesis.

Mediation results were found to be significant among the constructs. Therefore, giving support to H_6: Supply chain competence mediates the positive effect of strategic relationship with supply chain partner and innovation performance. The relationship between the strategic relationship with supply chain partner and innovation performance is mediated by supply chain competence with a bootstrap 95% confidence interval of 0.129 to 0.417 around the total indirect effect not containing zero. Additionally, giving a support to H_7: Supply chain competence mediates the positive effect of supplier involvement in NPD and innovation performance. The relationship between the supplier involvement in NPD and innovation performance is mediated by supply chain competence with a bootstrap 95% confidence interval of 0.022 to 0.136 around the total indirect effect not containing zero.

Table 5.19: The estimated direct, indirect and total effects

Effects			**Standardised Coefficients**	***Lower 95% CI***	***Upper 95% CI***	***p*-value**	***Hypotheses***	
Direct Effects								
SA	→	INV	0.202			*	H_1	Supported
INPD	→	INV	0.078			.105	H_2	Not supported
SA	→	SCC	0.389			***	H_3	Supported
INPD	→	SCC	0.114			**	H_4	Supported
SCC	→	INV	0.647			***	H_5	Supported
Indirect Effects								
SA	→	INV	0.252	0.129	0.417	***	H_6	Supported
INPD	→	INV	0.074	0.022	0.136	**	H_7	Supported
Total Effects (Direct Effects +Indirect Effects)								
SA	→	INV	0.326	0.196	0.499	***		
INPD	→	INV	0.927	0.748	1.133	***		

** = $p < .05$, ** = $p < .01$*** = $p < .001$. SA: Strategic Relationship with Supply Chain Partner; INPD: supplier involvement in NPD; SCC: Supply Chain Competence; INV: Innovation Performance*

Further analyses were carried out to find out if supply chain competence is a partial or a full mediator. The partially mediated model, unlike the full mediation model, provided a significant direct path between the independent variable and dependent variable, between supply chain collaboration strategies and innovation performance.

Results illustrated in Table 5.20 shows that both the direct and indirect effect of strategic relationship with supply chain partner on innovation performance were significant: direct (β=0.202,

p<0.05), Indirect (β=0.252, p<0.001). The study results show an occurrence of partial mediation as both the direct and indirect effects are significant. Therefore, it is possible that another potential mediator, carrying the same sign as the existing mediator, is 'hidden' in the direct effect (Zhao, Lynch & Chen 2010). Additionally, the results illustrated in Table 5.20 shows that the indirect effect of supplier involvement in NPD on innovation performance was significant (β=0.074, p<0.05), However the direct relationship was non-significant (β=0.078, p>0.05 ns). The study results show an occurrence of full mediation as the direct effect is non-significant and indirect effect is significant. In a full mediation process, the effect is 100% mediated by the mediator, that is, in the presence of the mediator (supply chain competence), the pathway connecting supplier involvement in NPD to innovation performance is completely broken so that supplier involvement in NPD has no direct effect on innovation performance.

Results inferred that strategic relationship with supply chain partner and supplier involvement in NPD contributes to the improvement of innovation performance via improving the supply chain competence. In other words, pharmaceutical manufacturers may achieve innovation performance when they improve their supply chain competence.

Table 5.20:The Mediation Results

Relationship	**Mediator**	**Standardised Coefficients (β) Direct Effect**	**Standardised Coefficients (β) Indirect Effect**	**Mediation Results**
SA → INV	SCC	0.202*	0.252***	H_6 Partial
INPD →INV	SCC	0.078ns	0.074**	H_7 Full

** = p < .05, ** = p < .01*** = p < .001. SA: Strategic Relationship with Supply Chain Partner; INPD: Supplier Involvement in NPD; SCC: Supply Chain Competence; INV: Innovation Performance*

5.17.2 Examining the Moderation Effect

Moderating variables changes the effect that the independent variable has on the dependent one (Preacher, Rucker & Hayes 2007). A moderator is more of a variable of a qualitative nature (e.g., gender, race, background) or quantitative nature (e.g., absorptive capacity as in this study) affecting the direction or intensity of the relationship between the independent and the dependent variables. This is the principle of statistical interaction where independent variables can individually have a different affect from their combined effect. Conceptually, this process implies that the magnitude of the direct effect of X (predictor) on Y (result) is dependent on the magnitude of the variable W (moderator; Preacher, Rucker & Hayes 2007).

Statistical analysis of research results, as is moderation analysis, is significantly enhanced by *z*-scores (Colan 2013). The *z*-score method applies to some of the most sensitive processes of analysis. The applicability of *z*-scores in moderation analysis is enhanced by their ability to allow for the comparative observations of different populations and distributions exemplified by different standard deviations and means, hence the determination of the extent of the deviation of a distribution from the normal mean of a normal distribution (Lavrakas 2008).

With respect to this study, two new variables have been created which include ZSAxABSC and ZINPDxABSC for testing the moderating role of absorptive capacity on the relationship between supply chain collaboration strategies and innovation performance. The proposed hypotheses H_8 and H_9 have been tested using AMOS 23.0 statistical software.

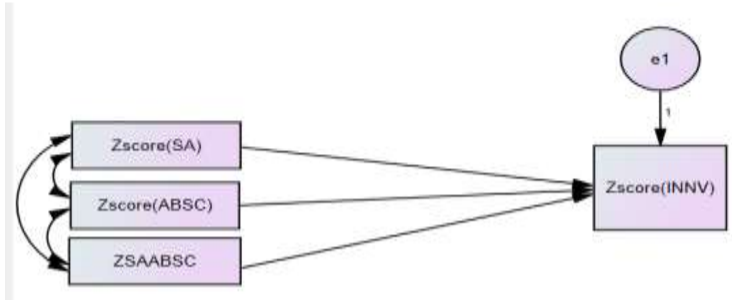


Figure 5.8: Moderation model (SA)

Table 5.21: Moderation Results (SA)

Relationship	Moderator	Standardised Coefficients (β)	Standard Error	Critical Ratio	P Value	Result
SA → INV	ABSC	0.014	0.049	0.281	0.779	H_8 Not supported

Figure 5.8 and Table 5.21 shows the estimated standardised path coefficients for the effect of the moderator (absorptive capacity) on the path from strategic relationship with supply chain partner to innovation performance (β=0.014, p>0.05) was not significant. This suggests that the representation of absorptive capacity has no moderating impact on the relationship. Other than that, the slope analysis shown in Figure 5.9 explains that there is no change on the moderator slope line. Hence, H_8 is not supported.

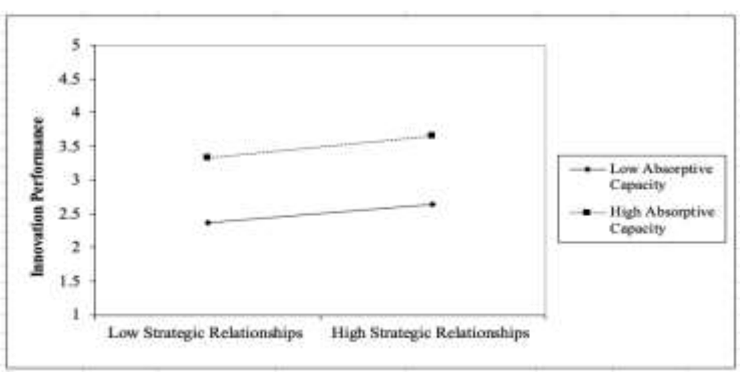


Figure 5.9: Interaction plot with moderator (Absorptive capacity)

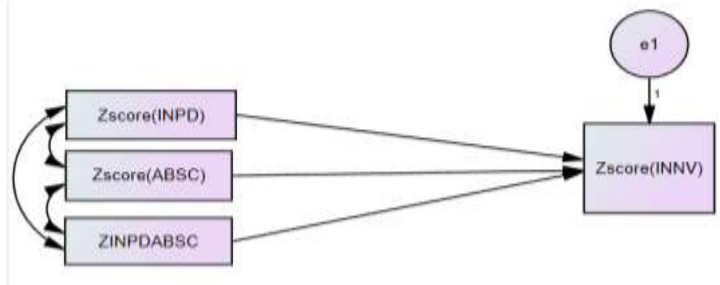


Figure 5.10: Moderation (INPD)

Table 5.22: Moderation Results (INPD)

Relationship	Moderator	Standardised Coefficients (β)	Standard Error	Critical Ratio	P Value	Result
INPD → INV	ABSC	0.071	0.046	1.541	0.123	H_9 Not supported

Figure 5.10 and Table 5.22 shows, the estimated standardised path coefficients for the effect of the moderator (absorptive capacity) on the path from supplier involvement in NPD to innovation performance (β=0.071, p>0.05) were not significant. This suggests that the representation of absorptive capacity has no moderating impact of innovation performance. Additionally, in Figure 5.11 the slope analysis shows that there is no change on the moderator slope line. Thus, H_9 is not supported.

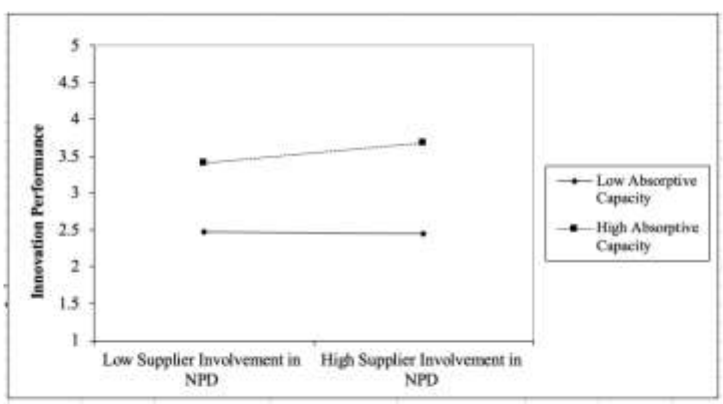


Figure 5.11: Interaction plot with moderator (Absorptive capacity)

Therefore, results don't provide the necessary support for H_8 and H_9. Hence, we can conclude that the direct relationship between strategic relationship and innovation performance is not moderated by absorptive capacity. Additionally, the same conclusion is applied on the direct relationship between supplier involvement in NPD and innovation performance. The results were exact; thus, the results do not provide the necessary support for H_8 and H_9.

Table 5.23: Summary of the hypotheses Results

Hypotheses	**Results**
H_1: Strategic relationship with supply chain partner is positively related to innovation performance.	Supported
H_2: Supplier involvement in NPD is positively related to innovation performance.	Not Supported
H_3: Strategic relationship with supply chain partner is positively related to supply chain competence.	Supported
H_4: Supplier Involvement in NPD is positively related to supply chain competence	Supported
H_5: Supply chain competence is positively related to Innovation performance.	Supported
H_6: Supply chain competence mediates the effect of strategic relationship with supply chain partner and innovation performance.	Supported
H_7 : Supply chain competence mediates the effect of supplier involvement in NPD and innovation performance.	Supported
H_8: Absorptive capacity moderates the relationship between strategic relationship with supply chain partner and innovation performance.	Not Supported
H_9: Absorptive capacity moderates the relationship between supplier involvement in NPD and innovation performance.	Not Supported

Table 5.23, above, shows the nine hypothesised relationships between strategic relationship with supply chain partner and innovation performance (H_1); Supplier involvement in NPD and innovation performance (H_2); Strategic relationship with supply chain partner and supply chain competence (H_3); Supplier involvement in NPD and supply chain competence (H_4); supply chain competence and innovation performance (H_5); Mediation role of supply chain competence on the relationship between strategic relationship with supply chain partner and innovation performance (H_6). Mediation role of supply chain competence on the relationship between supplier involvement

in NPD and innovation performance (H_7). Moderation role of absorptive capacity on the relationship between strategic relationship with supply chain partner and innovation performance (H_8). Moderation role of absorptive capacity on the relationship between supplier involvement in NPD and innovation performance (H_9). Of these nine proposed relationships, six (H_1, H_3, H_4, H_5, H_6 and H_7) were validated because they all had positive path standardized coefficients (β) and the $p<0.05$. H_2, H_8 and H_9 were the hypotheses which were not supported and validated even though they had positive path standardized coefficients **(β)**, however the results were significantly closer to zero and the $p>0.05$.

5.18 Summary

Data analysis and findings were highlighted and summarised in this chapter, which explained the tests that were conducted such as checking missing values, unengaged respondents, negatively worded items, reliability, and normality. There were no missing values, no research question that was negatively or reverse worded. The applied scales in this research were reliable. All tests were satisfactory.

Moreover, this chapter demonstrated both the measurement model and structural model which statistically had an acceptable model fit. The study investigated the influence of supply chain collaboration strategies on innovation performance and the role of supply chain competence and absorptive capacity. Out of the posited nine hypotheses, six (H_1, H_3, H_4, H_5, H_6 and H_7), were supported and validated, while H_2, H_8 and H_9 were the only three not supported in this study. Results showed that supplier involvement in NPD has a weak direct influence on the innovation performance. Thus, H_2, claiming a positive influence of supplier involvement in NPD on innovation performance, was not supported. Moreover, the results indicated that absorptive capacity does not moderate the relationship between strategic relationship with supply chain partner and innovation performance, as well and the relationship between supplier involvement in NPD and innovation performance in the pharmaceutical industry. Thus, H_8 and H_9 were not supported.

6 Chapter Six: Discussion of the Research Findings

The present research aimed to identify how the pharmaceutical industry can achieve innovation performance using supply chain collaboration strategies when influenced by factors such as absorptive capacity and supply chain competence. In order to meet the aim of the research, the following research questions were set out to be answered: *To what extent does strategic relationship with supply chain partner influence a pharmaceutical manufacturer's innovation performance?, To what extent does supplier involvement in NPD influence a pharmaceutical manufacturer's innovation performance?, To what extent does supply chain competence mediate the relationship between supplier involvement in NPD and innovation performance in the pharmaceutical manufacturing industry?, To what extent does supply chain competence mediate the relationship between strategic relationship and innovation performance in the pharmaceutical manufacturing industry?, To what extent does absorptive capacity moderate the relationship between strategic relationship and innovation performance in the pharmaceutical manufacturing industry?, To what extent does absorptive capacity moderate the relationship between supplier involvement in NPD and innovation performance in the pharmaceutical manufacturing industry?* To answer these research questions, data from 351 respondents from the pharmaceutical industry were collected and analysed using covariance-based SEM techniques. The methodology that was selected to collect the data was quantitative, which was underpinned by a positivist stance and a deductive approach.

This chapter first outlines the influence of strategic relationship with supply chain partner and supplier involvement in NPD on innovation performance, moreover, the influence of strategic relationship with supply chain partner and supplier involvement in NPD on supply chain competence. Following this, the mediating role of supply chain competence on the relationship between strategic relationship with supply chain partner and innovation performance as well as on the relationship between supplier involvement in NPD and innovation performance is discussed. Finally, the chapter outlines the role of absorptive capacity on moderating the relationship between supply chain collaboration strategies and innovation performance.

6.1 Influence of Strategic Relationship on Innovation Performance

It was hypothesised that there is a direct influence of strategic relationship with supply chain partner on innovation performance. This were found to be significant H_1 (β=0.202, p<0.05). The result of this study is in agreement with the theory of dynamic capabilities; the creation of strategic relationship with supply chain partner can lead to an increased rate of competitive advantage powered by innovation, which is created by the internal skills and organizational routines that firms have (Kraaijenbrink, Spender & Groen 2010). These internal competencies and organizational routines have been described as the role of the alliance itself, the assessment routines of the alliance, and the tasks and the instruments used (Felin et al. 2012; Eggers & Kaplan 2013). These procedures are also referred to as practices or micro-processes (Wang & Rajagopalan 2015; Vesalainen & Hakala 2014). These policies and activities would make it easier for a firm to use its expertise to further promote the sharing of resources across departments (Kraaijenbrink et al. 2010).

Furthermore, the results of the study aligned with the previous studies which revealed that strategic relationship can also result in NPD, innovation success, increased degree of product innovation, value-creation for customers, and an overall better quality and performance of products (Battor &

Battor 2010; Berghman et al. 2006; Lages et al. 2009; Ritter & Gemünden 2003; Sivadas & Dwyer 2000).

6.2 Influence of Supplier Involvement in NPD on Innovation Performance

It was hypothesised that there is a direct influence of supplier involvement in NPD on innovation performance. This was found to be non-significant H_2 (β=0.078, p>0.05 ns). Thus, underpinning the dynamic capability theory, the capability to continuously update the NPD process not only helps a firm to thrive in a dynamic environment, but also improves its NPD performance (Pavlou & El Sawy 2011). Firms that are able to develop specific capabilities, such as collective learning, collaborating, resource integration and sensing a dynamic environment, are better equipped to respond and adapt to an unpredictable environment, which improves their NPD efficiency and new product performance (Pavlou & El Sawy 2011). This finding is not agreeing with theory in this study and the previous researches that outlines the positive impact of suppliers' involvement in NPD on innovation performance. This could lead us to that the firms in the pharmaceutical industry are not effectively involving their suppliers in NPD to collectively learn and eventually improve the innovation performance. The extent to which supply chain participants collaborate with each other can vary. If the collaboration is very basic, it may not be enough to provide firms with a competitive edge over their competitors.

This finding is inconsistent with previous study which claim that the more involvement of suppliers in NPD the higher the level of performance can be achieved (Jap & Ganesan 2000). Additionally, Zimmermann et al. (2016) recognised that supplier involvement in NPD as a core supply chain strategy/approach that needed to enhance innovation performance. However, the hypothesis result did not find the same. The reason could be teams who operate in the pharmaceutical industry may be afraid to share their information and technical capabilities with the suppliers as Petersen, Handfield and Ragatz (2005) found in their study of the efficiency of NPD project teams involving engineers from manufacturing companies. In their study, most of the engineers expressed discomfort with sharing and discussing technological details if an extra member was included in their NPD team.

The finding is consistent with previous studies which state that supplier involvement in the NPD would not always result in improving effectiveness and productivity (Birou 1994, Hartley et al. (1997). Additionally, Johnsen (2009) as well, Primo and Amundson (2002) argue that management faces significant difficulties when it comes to the implementation of supplier involvement in NPD. Result shows that supplier involvement in NPD does not always enhance innovation performance, which supports Kähkönen et al.'s (2017) study that discussed supplier collaboration practices in the context of focal firm innovation performance. This study found that early supplier involvement, which is a supplier collaboration practice, did not impact innovation performance. In another study, Moon et al. (2018) explored the dependence of a firm's innovation performance on the involvement of supply chain collaborators at different stages of NPD. This study too showed that supplier involvement in NPD had no significant effect on the firm's innovation performance.

6.3 Influence of Strategic Relationship on Supply Chain Competence

The study hypothesised that strategic relationship with supply chain partner is positively related to supply chain competence (H_3). The data indicated support for this hypothesis (β=0.389, p<0.001). This result adds to the growing body of research that has found, to a generally consistent degree, that supply chain practices positively influence supply chain competence (Chow et al. 2008). While a vast body of prior research has not evaluated the concept of supply chain competence directly owing to the fact that this is a relatively newer concept, the result of this study furthers this essential area of study.

This finding is consistent with the theoretical reasoning of dynamic capability theory that firms can engage in this type of strategic relationship with supply chain partner and gain exploration and exploitation capabilities, which can then afford them greater supply chain competence. For instance, firms engaging in exploration activities focus on incoming knowledge, which is then exploited to generate newer alternatives production terms of product(s) or service(s) (Atuahene-Gima 2005; Ferreira et al. 2020; Garcia, Calantone & Levine 2003). This is the mechanism which underlies the concept of strategic relationship with supply chain partner such that firms can gain access to and acquire external knowledge based on the nature of the strategic relationship (Hagedoorn 1993; Hamel 1991; Inkpen 2000; Inkpen & Dinur 1998; Yang et al. 2015). Furthermore, the greater the relationship between the partners, the higher the opportunity that is available to the firm to learn (Sluyts et al. 2011), which is a core aspect of supply chain competence (Spekman et al. 2002). Researchers, in the most generic definition, conclude that competency is a mix of factors that are essential to performance (Enterprise Governance Consulting 2013; Murray

2003; Sánchez 2012; Ngo et al. 2014). Others argue that capabilities lead to competencies (Celine 2016; Spanos & Prastacos 2004).

Finally, the present study thus furthers the research area of supply chain competence as a dynamic capability and also adds new value in the context of the pharmaceutical industry. This finding to is believed to be noteworthy since it is new, as very few previous empirical evidence that directly links strategic relationship with supply chain partner to supply chain competence. Accordingly this finding is significantly contributes to the body of supply chain literatures on the subject that relate strategic relationship with supply chain partner with supply chain competence.

6.4 Influence of Supplier Involvement in NPD on Supply Chain Competence

It was hypothesised that supplier involvement in NPD is positively related to supply chain competence (H_4). The results of this research indicated support for this hypothesis (β=0.114, p<0.01). Supplier involvement in NPD affects information sharing between collaborating firms, while also building a shared competence for the whole supply chain. These results imply that supply chain participants that engage their suppliers in NPD can undergo collective learning and develop supply chain competence. These results follow the theory of dynamic capabilities, which posits that a firm can develop, modify, and integrate its internal and external competencies. Thus, supplier involvement in NPD can foster collective learning and create a competitive edge if firms invest in resources that are unique to the supply chain and complementary to the resources of their supply chain partners. Furthermore, if the firms in a supply chain invest in tangible and intangible assets specifically meant for their product development process, they can also develop a supply chain competence. In the absence of prior research explicitly linking supplier involvement in NPD with supply chain competence prior to this research, this study makes a novel contribution to the supply chain competence research field.

6.5 Influence of Supply Chain Competence on Innovation Performance

It was hypothesised that supply chain competence positively related to innovation performance (H_5). The results of the study indicated that there is support for the hypothesis (β=0.647, p<0.001) The positive role competences across several contexts has been identified previously. While this is the first study attempting to link supply chain competence and innovation performance, the role of supply chain competence in managing overall performance has been well established (e.g., Chow et al. 2008; Kannan & Tan 2005; Kuei et al. 2005). Furthermore, the research adds to the empirical studies linking collective learning and core competencies to innovation performance. Several scholars have highlighted the relationship between innovation and competences, stating that a firm's innovation capability is improved by its core competences. For example, innovation research scholars Zirger and Maidique (1990) identified the primary factors which influence product innovation. Many studies suggest that innovations are more successful when they fit in better with a firm's competences (Cooper & De Brentani 1991; Cooper & Kleinschmidt 1993; Kleinschmidt & Cooper 1991; Song & Parry 1997; Zirger & Maidique 1990).

Innovation performance has been underpinned by the dynamic capabilities' theory since the inception of the concept (Eisenhardt & Martin 2000; Teece et al. 1997). Thus, this research is furthering that area of research and is providing empirical evidence of the fact that supply chain competence as a dynamic capability which influences innovation performance. The mechanism with which supply chain competence influences innovation performance is that it generates either radical or incremental transformations in the services, products, or processes, and creates a new value for the firm which is then passed onto the customers through knowledge sharing (Narasimha & Narayanan 2013). In addition, innovation in a supply chain can result in generating accurate predictions of consumer demand, operations excellence, improve customer relations, and ensure revenue growth. Therefore, the primary contribution of this result to firms is that if they are able to enhance their supply chain competence, it is likely that their innovation performance will also increase substantially. This finding to the best of the researcher's knowledge is significant since it is new, as there is a limited previous empirical evidence that directly links supply chain competence and innovation performance.

6.6 The Mediating Role of Supply Chain Competence

This section discusses results of the two hypotheses: (H_6) Supply chain competence mediates the relationship between strategic relationship with supply chain partner and innovation performance; (H_7) Supply chain competence mediates the relationship between supplier involvement in NPD and innovation performance.

6.6.1 On Strategic Relationship & Innovation Performance

It was hypothesised that supply chain competence mediates the positive effect of strategic relationship with supply chain partner and innovation performance (H_6). The results indicated that there is support for the hypothesis's (β=.252, p<.001, 95% CI .129 to .417). By identifying the mediating role of supply chain competence on the relationship between strategic relationship with supply chain partner and innovation performance, the present study adds new knowledge with regards to this. In other words, past research has not yet identified the mediating effect of supply chain competence on the relationship between strategic relationship with supply chain partner and innovation performance.

This finding agrees with the dynamic capability theory used in this study. Capabilities are formed through the integration of processes as they are consider as the result of collective learning. Competencies are considered to be a set of activities/capabilities rather than single activity. Due to their strong "collectiveness," competencies can provide a firm with new patterns of products (Teece 1997; Hafeez, Zhang & Malak 2002) which can improve innovation performance.

The mediating role of supply chain competence can be understood by considering the following. There is a need for real-time collaboration and exchange of information between partners, which enhances the extent of planning and coordination of resources across the supply chain (Kohtamäki, Rabetino & Möller 2018). In addition, since strategic relationship with supply chain partner is a form of dynamic capability, as previously established, and dynamic capabilities are linked with innovation performance, forming strategic relationship with supply chain partner leads to greater supply chain competence, which can then enhance the rate of innovation performance. Innovation performance, in addition, is dependent upon ensuring that there is increasing investment in and incorporation of strategic resources and collective learning in the supply chain, which then leads to firms having a higher degree of innovation performance.

In addition, previous studies have also identified that when firms form strategic relationship with supply chain partner, this can lead to the creation of knowledge-sharing opportunities, greater collaboration and planning, and a high rate of synchronising activities (Francesco, Luciano & Silvia

2015 ; Kumar et al. 2017; Zhou et al. 2017). Moreover, strategic relationship with supply chain partner increase the rate of collaboration and integration, which enhances innovation performance (Yang & Hsu 2010). This is a novel finding in and of itself, as well as being a core contribution to the pharmaceutical industry. Finally, the empirical findings of the research have outlined that there is a potential partial mediating effect that supply chain competence has on the relationship between strategic relationship with supply chain partner and innovation performance. Partial mediation means there might be some other hidden factors in the direct relationship, leading to innovation performance. The results of the study show an occurrence of partial mediation as the both direct and indirect effects share the same sign. Thus, it is possible that there is another potential mediating factor "hidden" in the direct effect (Zhao et al. 2010).

6.6.2 On the Supplier Involvement in NPD & Innovation Performance

It was hypothesised that supply chain competence mediates the positive effect of supplier involvement in NPD and innovation performance (H_7). The result indicated that there is support for this hypothesis's (β=0.074, p<0.01, 95% CI 0.022 to 0.136). This is a novel finding of this research as none of the earlier studies have tested this hypothesis. This finding is agreeing with the theory of dynamic capability theoretical reasoning.

Therefore, this finding adds to the knowledge and outlines that the mechanism through which supplier involvement in NPD influences innovation performance is through increasing supply chain competence. Firstly, when buyers and suppliers collaborate for the generation of new products, the innovation performance is enhanced invariably due to the joining of resources and capabilities on innovation and product development (Bandara et al. 2017). The knowledge-sharing process can be enhanced such that when partners in the supply chain work as a unit, they can use different resources and competences to create new products (Cho, Kim & Jeong 2017).

Moreover, past research has advocated for the need to have early and extensive supplier involvement leading to a faster development process (Füller et al. 2006; Hoyer et al. 2010), which can aid in enhancing competitiveness in the supply chain. Therefore, this research makes a novel contribution to the growing body of research surrounding supply chain competence and innovation performance. Finally, the results of this study have also outlined that there is a full mediating influence of supply chain competence on the relationship between supplier involvement in NPD and innovation performance, which places emphasis on the importance of the supply chain competence to enhance innovation performance when firms involve their suppliers in the NPD process.

6.7 The Moderating Role of Absorptive Capacity

The absorptive capacity of a firm can also facilitate other firms to extend their knowledge in innovation to oversee stock production, as well as gain valuable insights from market dynamics and relationships with their partners and competitors (Liu et al. 2013). Furthermore, an external network can lead to a higher degree of innovation performance (Rosell, Lakemond & Melander 2017; Taghizadeh et al. 2018; Wang & Kafouros 2018). In addition, with the use of the process of reconfiguration of dynamic capabilities, essential knowledge is acquired by the firm, which is then transformed into a product (Senivongse, Bennet & Mariano 2019).

Furthermore, these hypotheses were formulated with the understanding that innovation is increasingly dependent on the extent to which the firms can obtain external information (Tran, Hsuan & Mahnke 2011). Thus, it was thought that there is an indirect mechanism (moderation effect) through which absorptive capacity influences the innovation performance. However, this was proven in the present research, which has found inconclusive moderation results of absorptive capacity. The next section with discuss the hypotheses results and study findings of the moderating role of absorptive capacity.

6.7.1 On the Strategic Relationship & Innovation Performance

It was hypothesised that H_8: Absorptive capacity moderates the relationship between strategic relationship with supply chain partner and innovation performance, such that absorptive capacity increases the strength of the positive relationship between strategic relationship with supply chain partner and innovation performance. However, this hypothesis was not supported by the result because the estimated standardized path coefficients for the effect of the moderator (absorptive capacity) on the path from strategic relationship with supply chain partner to innovation performance was non-significant, H_8 (β=0.014, p>0.05), thus it is inferred that the direct effect is not conditional on the level of the moderator variable. However, Narasimhan and Narayanan (2013) state that a firm's absorptive capacity is crucial to ensure that the knowledge contributed by the other actors in the supply chain is used effectively for innovation. The present study, however, did not support this statement.

The result add to the body of research that has identified non-significant role of absorptive capacity on supply chain partnership models (Kauppi et al. 2013; Ishihara & Zolkiewski 2017; Wagner

2012; Zacharia et al. 2011). Absorptive capacity does not moderate such relationships. This means that collaborating with supply chain partner in strategic relationship leads to innovation performance regardless of the impact of the firm's absorptive capacity.

Even though the observed result was not statistically significant, it still lay in the hypothesized direction, thereby corroborating Ishihara and Zolkiewski (2017)'s assumption, cited by Roldán Bravo et al. (2020) "absorptive capacity may lack value for the receiver of knowledge when the sender's disseminative capacity is low". Thus, absorptive capacity of the receiver is insufficient if the source of knowledge transfer is not able to disseminate it in appropriate way. If a source's signal is very weak, even a high-performance receiver cannot catch the signal. Another possible reason could be the fact that firms in the sample for this study are unable to optimize their knowledge utilisation, which can lead to negative effects of absorptive capacity (Vasudeva & Anand 2011). This has led us to understand why the absorptive capacity of the pharmaceutical industry in this study does not moderate the relationship between strategic relationship with supply chain partner and innovation performance.

6.7.2 On the Supplier Involvement in NPD & Innovation Performance

It was hypothesised that H_9: Absorptive capacity moderates the relationship between supplier involvement in NPD and innovation performance, such that absorptive capacity increases the strength of the positive relationship between supplier involvement in NPD and innovation performance. However, this hypothesis was not supported by the result because the estimated standardised path coefficients for the effect of the moderator (absorptive capacity) on the path from supplier involvement in NPD to innovation performance was non-significant, H_9 (β=.071, p>.05).

Thus, it is inferred that the direct effect is not conditional on the level of the moderator variables. This was hypothesised due to the fact that knowledge sharing among partners leads to the generation of higher innovation (Pouwels & Koster 2017; Yunus 2019).

The current research has generated an inconclusive finding. This is in stark contrast to the study by Flatten et al. (2011), who found there is a direct link between absorptive capacity and innovation success since such capacities support the adaptability of a firm to different influences, both internally and externally. In essence, absorptive capacity enables firms to leverage what they know and do not know, and to employ external knowledge from suppliers, which can lead to higher innovation performance. However, the present research has shown that there is no moderation influence of absorptive capacity on the relationship between supplier involvement in NPD and innovation performance. Furthermore, the results are also in contrast with the fact that absorptive capacity of a firm allows it to expand its knowledge in innovation to cover production, stocking, and understanding market dynamics and relationships with its partners and competitors (Liu et al. 2013), which has the potential to increase innovation performance.

Additionally, it is also necessary to consider the case of the pharmaceutical industry in understanding the inconclusive result. One of the causes for this could be that pharmaceutical-related firms are not engaging in an effective knowledge-sharing mechanism due to potential patent and intellectual property rights-related regulations. Moreover, Qureshi and Evans (2013) conducted a case study on the pharmaceutical industry and found that the industry as a whole did not engage in knowledge-sharing practices. Therefore, it is possible that the firms in the present study did not engage in maintaining an effective balance between their knowledge transfer capacities in the supply chain.

Finally, another potential reason for the inconclusive effect could be that there is an influence of time. In other words, the development of absorptive capacity can potentially occur over a certain time period. This process can occur over a lengthy period of time, especially in the pharmaceutical industry, due to the time it takes for R&D to become commercially fruitful. Therefore, to effectively measure the absorptive capacity and its moderating influence on the relationship between supply chain collaboration strategies and innovation performance, the researchers need to conduct a longitudinal study and evaluate how absorptive capacity develops in an organisation. However, more researches are needed to identify the potential causes for this inconclusive results in the context of the pharmaceutical industry.

6.8 Summary

This chapter has summarised and emphasised on the main findings of this research. The research hypotheses were appropriately and separately discussed. The results of this study included four sentiments: First, strategic relationship with supply chain partner play a fundamental role in the influence of innovation performance; Second, supply chain competence plays an active role in mediating the relationship between supply chain collaboration strategies (strategic relationship with supply chain partner and supplier involvement in NPD) and innovation performance; Third, supply chain competence is positively associated with innovation performance; Last, inconclusive results of absorptive capacity on moderating the relationship between supply chain collaboration strategies (strategic relationship with supply chain partner and supplier involvement in NPD) and innovation performance. Theoretical and practical contributions of research findings, research limitations and recommendations for future research are provided in Chapter Seven.

7 Chapter Seven: Conclusion and Contribution

In this chapter, the researcher presents concluding remarks, theoretical and practical contributions, as well as limitations of the research. Finally, suggestions for possible future research are also offered.

7.1 Research Concluding Remarks

The present research was crucial to be conducted due to the fact that effectively managing the supply chain of the pharmaceutical industry is of critical importance due to the nature of the industry and rapid R&D changes. This is due to the fact that the pharmaceutical supply chain needs effective links between the laboratory and the marketplace. In order to fully exploit the capabilities of their supply chain and improve their expertise, businesses need to develop complex supply chain-specific capabilities. During periods of crisis, such as the global COVID-19 pandemic that has pushed the limits of the worldwide health and pharmaceutical industry, this becomes more significant. This study provides an empirical evidence of the relationship between supply chain collaboration strategies, supply chain competence, absorptive capacity, and innovation performance.

The outcomes of the present study proved to be more interesting than initially anticipated. The results we obtained from participants in the pharmaceutical industry show that innovation performance can be improved by employing the collaborative capabilities created in certain supply chain collaboration strategies (strategic relationship with supply chain partner and supplier involvement in NPD) and the role of supply chain competence. Considering the different types of supply chain collaboration strategies being undertaken by the supply chain partners, it was crucial that the used resources and sharing capabilities were closely connected to develop supply chain competence that enhance innovation performance. It shows how supply chain competence plays a vital role in the relationship, which adds to the literature of dynamic capability theory. Pharmaceutical industry-related firms need to learn how to manage their supply chain collaboration strategies that will benefit them and improve their current capabilities that will also assist them in exploring supply chain competences that can ensure they are attaining optimum innovation performance. The analysis of the empirical study suggests that the pharmaceutical industry should think about the significant improvements afforded by establishing a strategic relationship with supply chain partner. Pharmaceutical firms need to transfer the supply chain competence, developed through cooperative interaction with supply chain partners, to their partners, as the latter are the key to ensure innovation performance. The results lend confidence to our view of strategic relationship with supply chain partner and supplier involvement in NPD being both dynamic capabilities and able to open up new views of understanding as to the potential influence on innovation performance. As a dynamic capability, strategic relationship with supply chain partner and supplier involvement in NPD are strategies used by firms to acquire and integrate resources, both internal and external to the firm, and to sense and seize opportunities for developing their supply chain competence that enabled them enhance their innovation performance to cope with uncertainty in the market.

The theory of dynamic capabilities was first created to describe the role of time in the growth of competitive advantage (Augier & Teece 2007; Lockett & Wright 2005; Pitelis 2007). It is an extension of a firm's resource-based view that suggests that the presence of capital is adequate for businesses to achieve a competitive advantage (Teece & Pisano 1994). The theory of dynamic capabilities puts a high degree of focus on the organizational learning process that is important for businesses. The firm's ability to assess and adapt to the external environment is important for its success. This also makes it easier to understand why, in terms of their performance, businesses vary from each other, all else being equal. In addition, the idea of creating routines and path dependencies that will help an organisation to respond to an ever-changing external environment needs to underpin the successful management of that organisation (Augrier & Teece 2007).

It was also hypothesised that absorptive capacity moderates the relationships between strategic relationship with supply chain partner and innovation performance. Moreover, it was also hypothesised that absorptive capacity moderates the relationships between supplier involvement in NPD and innovation performance. However, these hypotheses were not supported by the results of the study. One of the possible reasons could be the assumption of Ishihara and Zolkiewski (2017) that “absorptive capacity may lack value for the receiver of knowledge when the sender’s disseminative capacity is low”. An additional reason could be the fact that firms in the sample of this study are unable to optimize their knowledge utilization, which can lead to negative effects of absorptive capacity. Another possible reasons could be that the firms in the study did not engage in maintaining an effective balance between absorptive capacity in their supply chain, or that the pharmaceutical firms are not engaging in an effective knowledge-sharing mechanism due to potential patent and intellectual property rights-related regulations. An additional, potential reason for the inconclusive result could be that there is an influence of time. The development of absorptive capacity can potentially occur over a certain time period. More research is needed to outline the underlying factor responsible for this inconclusive effect. Research results have shown that there is no influence of absorptive capacity on moderating the relationships between strategic relationship, supplier involvement in NPD, and innovation performance.

Finally, this study concludes that for developing innovation performance, firms need to consider the development of their supply chain collaboration strategies and supply chain competence. More empirical researches are needed to aware the scholars and managers regarding the development of supply chain collaboration strategies and creation of supply chain competence that can lead to enhanced innovation performance.

7.2 Theoretical Contributions

With respect to the theoretical contributions of this study are concerned, this study makes several. The study contributes to our understanding of certain related constructs that have not been explored in depth in previous literatures related to factors influencing innovation performance. It is one of few studies that investigate antecedents of innovation performance, while most studies in the supply chain literature focus on financial performance and operational performance, we examine innovation performance itself, e.g., the speed of new products development is fast enough/ competitive. This study sheds light on the possibility of enhancing the innovation performance of the pharmaceutical industry by establishing strategic relationship with supply chain partner and involve suppliers in the NPD process, which could lead to generate supply chain competence that enhances innovation performance.

Moreover, the study thus aids in develop an understanding of the mechanism of the impact of supply chain collaboration strategies on innovation performance through the supply chain. In this regard, the findings of this study reinforce the necessity to develop and test the theoretical model that acknowledges the main supply chain strategies/approaches that tend to positively affect the innovation performance (Zimmermann et al. 2016). In additional to Zimmermann's et al. (2016) study, the present study contributes that the relationship between supply chain collaboration strategies and innovation performance is mediated by supply chain competence and might by some other numerous variables that connect the constructs in indirect way. Thus, by doing so, the present study makes this core contribution to the supply chain management and innovation research.

Although past research has emphasised on the role of supply chain competence for achieving overall performance (Chow et al. 2008), relatively no research has focused on the role of supply chain competence on innovation performance, which is the new competitive advantage in the modern business environment (Bashir & Verma 2017, p.7). The present research bridged this gap by highlighting the important parts that supply chain competence plays as a dynamic capability, and as a mediator in the relationship between supply chain collaboration strategies and innovation performance. Thus, the present research elucidated concepts that have as yet not been elaborated in supply chain management literature. Our results indicate that such supply chain competence is likely to fully mediate the effects of supplier involvement in NPD on innovation performance. However, supply chain competence partially mediates the effects of strategic relationship with supply chain partner on innovation performance, which indicate that other factors influence the relationship. It is the first study that explicitly tests if supply chain competence is an important factor in understanding supply chain collaboration strategies effect. The study also contributes to the present supply chain competence literatures by offering comprehension of the role and value of supply chain collaboration strategies and what factors influence the occurrence of the relationship. Although supply chain competence is crucial to success of business, the subject is still unclear and there is a need for more explicit researches on the subject, which is thus filled by the present research.

In addition, this study contributes to the literatures by adding to the dynamic capability theory and adding to the literature linking the supply chain and dynamic capabilities (Masteika & Čepinskis 2015). This study has identified supply chain competence, strategic relationship with supply chain partner, supplier involvement in NPD, and absorptive capacity as dynamic capabilities and denotes that the use of the study constructs as dynamic capabilities has not been conducted to a large extent. Dynamic capabilities theory affords an effective theoretical basis to study the relationship between supply chain collaboration strategies, supply chain competence, and innovation performance. Supply chain collaboration strategies can, in essence, represent the internal and external structure through which a firm senses the environment, learns from the environment, and integrates and coordinates internally and externally with its supply chain partners.

Moreover, this thesis contributes to the literature by creating an original conceptual model shown in Chapter Three Figure 3.1. It offers a guide to other researchers and practitioners interested in understanding the role of supply chain collaboration strategies on innovation performance and the role of supply chain competence on mediating the relationship. Nevertheless, there is no single study that has delved into this exact area. This conceptual model can guide future research into considering supply chain collaboration strategies to improve innovation performance in order to meet challenges and uncertainty of the market that is facing the pharmaceutical industry.

Lastly, the invalidation of H_8 and H_9 (Moderating role of absorptive capacity) also can support academics to think about additional questions to recognise what other capabilities might impact the relationship between supply chain collaboration strategies and innovation performance. In other words, identify other conditions that could impact the direct relationship. This section discussed the theoretical contribution, and the following section will discuss the practical contribution.

7.3 Practical Contributions

The identification and highlighting of practical contributions to business managers are the primary aim of any business study. The current business study and it analysis highlights numbers of practical contributions.

Thus, this study assists the senior managers in pharmaceutical industry to advance their comprehension of the advantages of applying supply chain collaboration strategies, as stated in this research on strategic relationship with supply chain partner and supplier involvement in NPD in terms of developing innovation performance. This will encourage these managers to implement supply chain collaboration strategies in an attempt to develop strong innovation performance.

Pharmaceutical manufacturing supply chain/inventory/procurement/logistic managers required to build knowledgeable decisions that is based on scientific research regarding the benefits of use such supply chain collaboration strategies to improve innovation performance. Additionally, collaboration with suppliers will also be of great benefit, hence making firms more than capable of pinpointing areas for possible improvement in product quality and processes, as they will be shared throughout the supply chain. Using supply chain collaboration strategies enhances the output and process, balancing the inherent risk of the unknown with the targeted reward of success.

As mentioned previously, the data suggest that setting up strategic relationship with supply chain partner helps in promoting innovation of products and services in the pharmaceutical industry. Strategic relationship with supply chain partner is part of a process of sharing a firm’s resources and capabilities. Strategies have been used to link the available resources and capabilities according to the required objectives, by promoting competence. Such alignment helps in structuring those businesses in the pharmaceutical industry according to the needs of users and valued customers in the market.

Another strategy mentioned in the study is supplier involvement in NPD, which involves the development of new products, that covers the entire process of inventing a new product for the marketplace. It has the capacity of exchanging potential information and developing new medicines in integrated systems. The main elements of supplier involvement in NPD require a unique product design which covers all the objectives regarding customer demand and business requirements. Such strategies not only aid in enhancing the management of the industry, but also help develop competences to increase the innovation performance in the pharmaceutical industry. Accordingly, this study can improve ability of the managers in the pharmaceutical industry to decide regarding the relationships with supply chain partners and to develop relationships that support them to enhance innovation performance to face uncertainty in the market. Such supply chain collaboration strategies add value to stakeholders, buyers, patients, and health-related practitioners and providers.

Consequently, firms in the pharmaceutical industry need to realize the importance of their combined capabilities and developing supply chain competence through supply chain collaboration strategies which improve their innovation performance, essential during those difficult times when the supply chain gets disrupted. As recommended by the results, it is crucial to appropriately manage and understand the variables that affect the maintenance and continuity of a firm's business in uncertain environments. This study offers perspectives that can help managers in the pharmaceutical industry to broaden their solution portfolio for improving innovation performance to face uncertainty in the market. Research results in this section revealed practical contributions, and the following section discusses the research limitations.

7.4 Research Limitations

Similar to many studies, this study contains certain limitations. The first limitation of the study is the adoption of a positivist paradigm approach. Other scholars may seek to investigate this study from either using an interpretive, inductive, and qualitative approach, or through applying a positivist and an interpretive as a mixed-methods approach (Creswell et al. 2003). Adopting these approaches provides opportunities for an in-depth analysis of the results. Adopting a mixed-methods or a qualitative approach facilitates a detailed examination of the data and allows the researcher's perspective to impact the results. However, this quantitative research approach was suitable for the research questions in the study as the objective of the study employs hypotheses, statistics, and structural equation modelling. The use of a deductive approach allowed the researcher to understand the predictability of the relationship of the independent variables to the dependent variables. This method was selected as it allows causality, encourages objectivity, and offers the ability to imitate studies in different contexts. Additionally, for sectors of the pharmaceutical industry located all over the world, the survey method was more suitable to collect data. Due to the researcher's familiarity with the industry, it was imperative to keep a distance from the phenomena under study. The second limitation is the single-industry approach. Some consider this approach as limiting the general ability of the results to be applied to a wider population than simply the pharmaceutical industry. However, this approach allows other researchers to imitate this study in different industrial contexts. This section discussed the study's limitations, and the following section discusses directions for future research in more detail.

7.5 Research Future Recommendations

The results of the research reveal new paths for further research and methodological applications. Besides the quantitative approach, studies could be conducted to generate in-depth qualitative data which focus on the role of absorptive capacity, and thus gain a better understanding of its role. Applying a mixed-method approach would be especially appropriate to examine the effect of absorptive capacity. Furthermore, researchers also could consider use innovation performance as a multidimensional construct to understand what dimension of innovation performance could be improved more by the effect of supply chain collaboration strategies, is a product/service or process innovation. Lastly, research model could be expanded in the future research by including additional strategies such as open innovation strategy.

7.6 Summary

This chapter has explained the results found from this study. It has addressed in detail the implications and concluding remarks as well as illustrated the theoretical contributions and practical contributions, limitations, and recommendations for future research directions. The conclusions drawn from the study are that strategic relationship with supply chain partner and supplier involvement in NPD both are supply chain collaboration strategies used in the pharmaceutical industry can benefit from the variation in knowledge which is present in the supply chain and which can be widely used to uplift innovation performance. Such strategies not only add value to the pharmaceutical industry's stakeholders and buyers, but also add significance to health care service providers and health care service seekers.

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9 Appendices

APPENDIX 9.1: MEASUREMENTS SCALE

Strategic relationship (Oke et al. 2013)	
SA1	We expect our relationship with the key supply chain partners to last a long time.
SA2	We collaborate with the key supply chain partner to improve performance in the long run.
SA3	The supply chain partner sees our relationship as a long-term alliance
SA4	We view our supply chain partner as an extension of our company.
Supplier Involvement in NPD (Chen & Paulraj 2004)	
INPD1	We involve key suppliers in the product design and development stage.
INPD2	We have key supplier membership/participation in our project teams.
INPD3	Our key suppliers have major influence on the design of new products
INPD4	There is a strong consensus in our firm that supplier involvement is needed in product design/development
Absorptive Capacity (Wagner 2012)	
ABSC1	We are able to identify and use relevant knowledges from our supply chain
ABSC2	We have adequate routines to analyse external knowledge from this supply chain
ABSC3	We can successfully combine new knowledge obtained from this supply chain with existing knowledge
ABSC4	We can successfully exploit new knowledge in concrete applications
Innovation performance (Chong et al. 2011)	
INV1	We are fast in adopting processes with the latest technological innovation
INV2	We use up-to-date/new technology in the process

INV3	We use the latest technology for new product development
INV4	The process, techniques and technology change rapidly in our company
INV5	We have enough new products introduced to the market
INV6	We have new products which are first in market (early market entrants)
INV7	The speed of new product development is fast enough/ competitive
INV8	We are technologically competitive
INV9	We are able to produce products with novelty features
Supply Chain Competence (Roldán Bravo, Moreno & Llorens-Montes 2016)	
SCC1	Our ability to respond to requests in a timely manner is excellent
SCC2	Our ability in filling orders with improved accuracy is excellent
SCC3	Our ability to make high-quality products and provide high-quality services is excellent
SCC4	Our ability to respond to the needs of key customers and with key suppliers is excellent
SCC5	Our ability in managing supply chain inventory is excellent
SCC6	Our ability to meet promised delivery date is excellent
SCC7	Our ability to issue advanced notice on shipping delays is excellent
SCC8	Our ability to enhance the supply chain’s position in terms of integrity is excellent

APPENDIX 9.2: SURVEY QUESTIONNAIRE

SECTION 1: Demographic Profile

Please choose at the appropriate box

Gender:

- ❑ Male
- ❑ Female

Job title:

- ❑ VP supply chain operation
- ❑ Supply chain Manager/Director
- ❑ Inventory Manager/Director
- ❑ Logistic and Distribution Manager/Director
- ❑ Procurement Manager/Director
- ❑ Director of supply chain planning
- ❑ Head of supply chain management
- ❑ Key Account Manager
- ❑ Other (please specify)

Job level:

- ❑ Operational Manager
- ❑ Middle Manager
- ❑ Senior Manager/Director

Company headquarter location:

- ❑ Africa
- ❑ Asia
- ❑ Europe
- ❑ North America
- ❑ South America
- ❑ Oceania

How many years has the company you work for been **operating in the market?**

❑ Less than 3 Years ❑ 4 – 6 Years ❑ 7 – 9 Years ❑ 10 – 12 Years ❑ 13 – 15 Years ❑ 16 – 18 Years ❑ 19 – 21 Years ❑ More than 21 Years

The range of the company's number of employees:

❑ Less than 1,000 Employees ❑ 1,000 - 5,000 Employees ❑ 5,001 - 10,000 Employees

❑ 10,001 - 30,000 Employees ❑ 30,001 - 50,000 Employees ❑ More than 50,001 Employees

SECTION 2: Supply Chain Collaboration Strategies

A. Strategic relationship with supply chain partner

Please indicate your level of agreement on the following statements based on your experience working in your company. *<u>The rating is from Strongly Disagree to Strongly Agree</u>*

Question	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
We expect our relationship with the key supply chain partners to last a long time.							
We collaborate with the key supply chain partner to improve performance in the long run.							
The supply chain partner sees our relationship as a long-term alliance							
We view our supply chain partner as an extension of our company.							

B. Supplier Involvement in NPD

Please indicate your level of agreement on the following statements based on your experience working in your company. The rating is from Strongly Disagree to Strongly Agree

Question	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
We involve key suppliers in the product design and development stage.							
We have key supplier membership/participation in our project teams.							
Our key suppliers have a major influence on the design of new products							
There is a strong consensus in our firm that supplier involvement is needed in product design/development							

SECTION 3: Absorptive Capacity

Absorptive Capacity is its ability to identify, assimilate, transform and apply external knowledge.

Please indicate your level of agreement on the following statements based on your experience working in your company. The rating is from Strongly Disagree to Strongly Agree

Question	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
We are able to identify and use relevant knowledge from our supply chain							
We have adequate routines to analyse external knowledge from this supply chain							
We can successfully combine new knowledge obtained from this supply network with existing knowledge							
We can successfully exploit new knowledge in concrete applications							

SECTION 4: Innovation Performance

Please indicate your level of agreement on the following statements based on your experience working in your company. *<u>The rating is from Strongly Disagree to Strongly Agree</u>*

Question	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
We are fast in adopting processes with the latest technological							
We use up-to-date/new technology in our processes process							
We use the latest technology for new product development							
The process, techniques and technology change rapidly in our company							
We have enough new products introduced to the market							
We have new products which are first in market (early market entrants)							
The speed of new product development is fast enough/ competitive							
We are technologically competitive							
We are able to produce products with novelty features							

SECTION 5: Supply Chain Competence

Please indicate your level of agreement on the following statements based on your experience working in your company. The rating is from Strongly Disagree to Strongly Agree

Question	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neutral	Slightly Agree	Moderately Agree	Strongly Agree
Our ability to respond to requests in a timely manner is excellent							
Our ability in filling orders with improved accuracy is excellent							
Our ability to make high-quality products and provide high-quality services is excellent							
Our ability to respond to the needs of key customers and key suppliers is excellent							
Our ability in managing supply chain inventory is excellent							
Our ability to meet promised delivery dates is excellent							
Our ability to issue advanced notice on shipping delays is excellent							
Our ability to enhance a supply chain's position in terms of integrity is excellent							

This is the end.
Your kind participation is much appreciated.
Thank you.

APPENDIX 9.3: APPROVAL FROM THE BuiD's BOARD AND ETHICAL COMMITTEE

The British University in Dubai

Research Research Ethics Form (Low Risk Research)

To be completed by the researcher and submitted to the Dean's nominated faculty representative on the Research Ethics Committee

i. Applicants/Researcher's information:

Name of Researcher /student	Noura Mohamed obaid Al Zaabi
Contact telephone No.	00971503280362
Email address	2016156004@student.buid.ac.ae
Date	16/12/2018

ii. Summary of Proposed Research:

BRIEF OUTLINE OF PROJECT (100-250 words; this may be attached separately. You may prefer to use the abstract from the original bid):	Attached
MAIN ETHICAL CONSIDERATION(S) OF THE PROJECT (e.g. working with vulnerable adults; children with disabilities; photographs of participants; material that could give offence etc…):	• The researcher has no personal interest or gain in the study except for the purely scientific interest in the research topic under consideration • Ensure of confidentiality and anonymity of the participants. No harm possibility to individual from participating in the study. • Participation in the study is voluntary and the participants in the study is willing and they are free from any coercion. • The participants will be asked to sign the informed consent form, they have the right to withdraw and stop at any time. • The participants can contact by email, post or telephone for questions or concerns about this study or if any problems arise, as well If they have any questions or concerns about their rights as a research participant **British university in Dubai:** Prof. Stephen Wilkins, Head of Master of Business Administration and BSc. in Business Management programmes Tel: +971 4 279 1400 Ext: 482 Fax: +971 4 279 1490 Email: stephen.wilkins@buid.ac.ae
DURATION OF PROPOSED PROJECT (please provide dates as month/year):	data collection will start on April/2019 end July/2019
Date you wish to start Data Collection:	Pilot study February /2019, Actual data collection will start on April/2019
Date for issue of consent forms:	/ 2 /2019

iii. Declaration by the Researcher:

I have read the University's policies for Research and the information contained herein, to the best of my knowledge and belief, accurate.

I am satisfied that I have attempted to identify all risks related to the research that may arise in conducting this research and

APPENDIX 9.4: ELECTRONIC CONSENT FORM TO PARTICIPATE IN THE SURVEY

Dear Sir/Madam,

This survey examines various aspects of the supply chain, innovation, and knowledge capacities in the pharmaceuticals industry. Your participation is critical to the success of the study. This research is entirely for academic purposes and any information that you share will be used anonymously and with confidentiality. Your name will not be identifiable in the data set or the findings.

Your participation in this research study is voluntary. You can decide not to participate further in this study once you have started.

The procedure involves completing an online survey that will take approximately 7 minutes. Your responses will be confidential, and we do not collect identifying information such as your name, email address or IP address. We are only interested in your assessment of your organisation's activities.

All data is stored in a password-protected electronic format. To help protect your confidentiality, the surveys will not contain information that will personally identify you. The results of this study will be used for scholarly purposes only and may be shared with British University in Dubai (BUiD) representatives.

ELECTRONIC CONSENT: Please select your choice below. Clicking on the "agree" button below indicates that:

You have read the above information
You voluntarily agree to participate
You are a Middle/Senior Manager / Director
You have knowledge of your organisation's supply chain operations and strategies

* 1. If you wish to participate in the survey and agree/comply with the above, please click on the "Agree" button below; click "Disagree" if you do not wish to participate.

○ Agree ○ Disagree

APPENDIX 9.5: PRE-STUDY ASSESSMENT

Dear Participant,

Your participation is essential to let us develop questionnaire that is comprehensive. After completing the questionnaire, we would like you please to get your feedback by answering following questions:

1. How long did the survey take to complete?
2. Are the instructions for each section clear and unambiguous?
3. Are the questions direct and concise?
4. Are the questions free of unnecessary technical language and jargon?
5. Are there any questions which make you feel uncomfortable, embarrassed, annoyed, or confused? If so, can these be worded differently to avoid doing so?
6. To maximise the questionnaire's quality, please provide any other comments/information that you feel may be useful.

Thank you for your assistance in advance

Noura Al Zaabi,
PhD Student – British University in Dubai